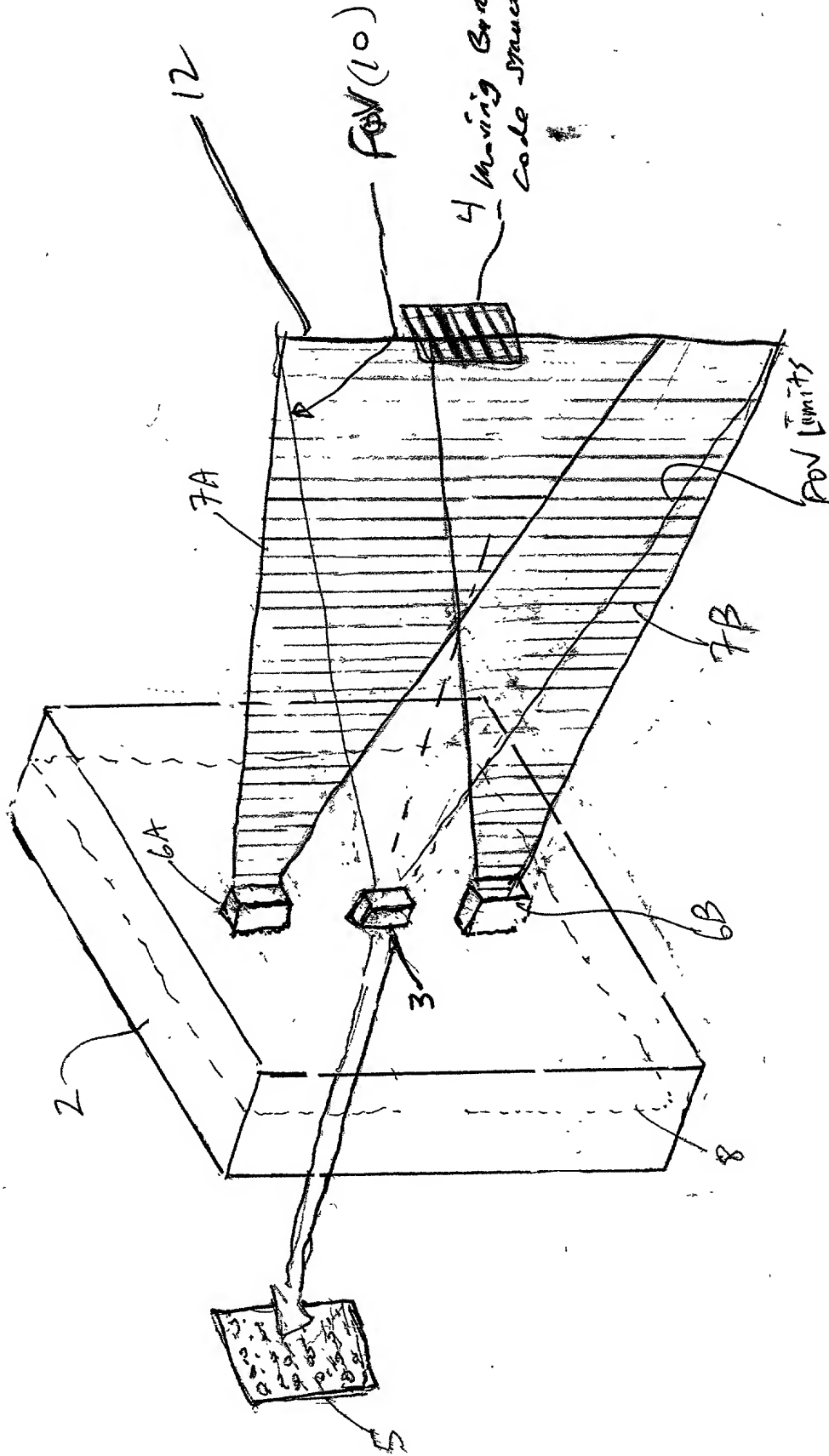


108-127USA000

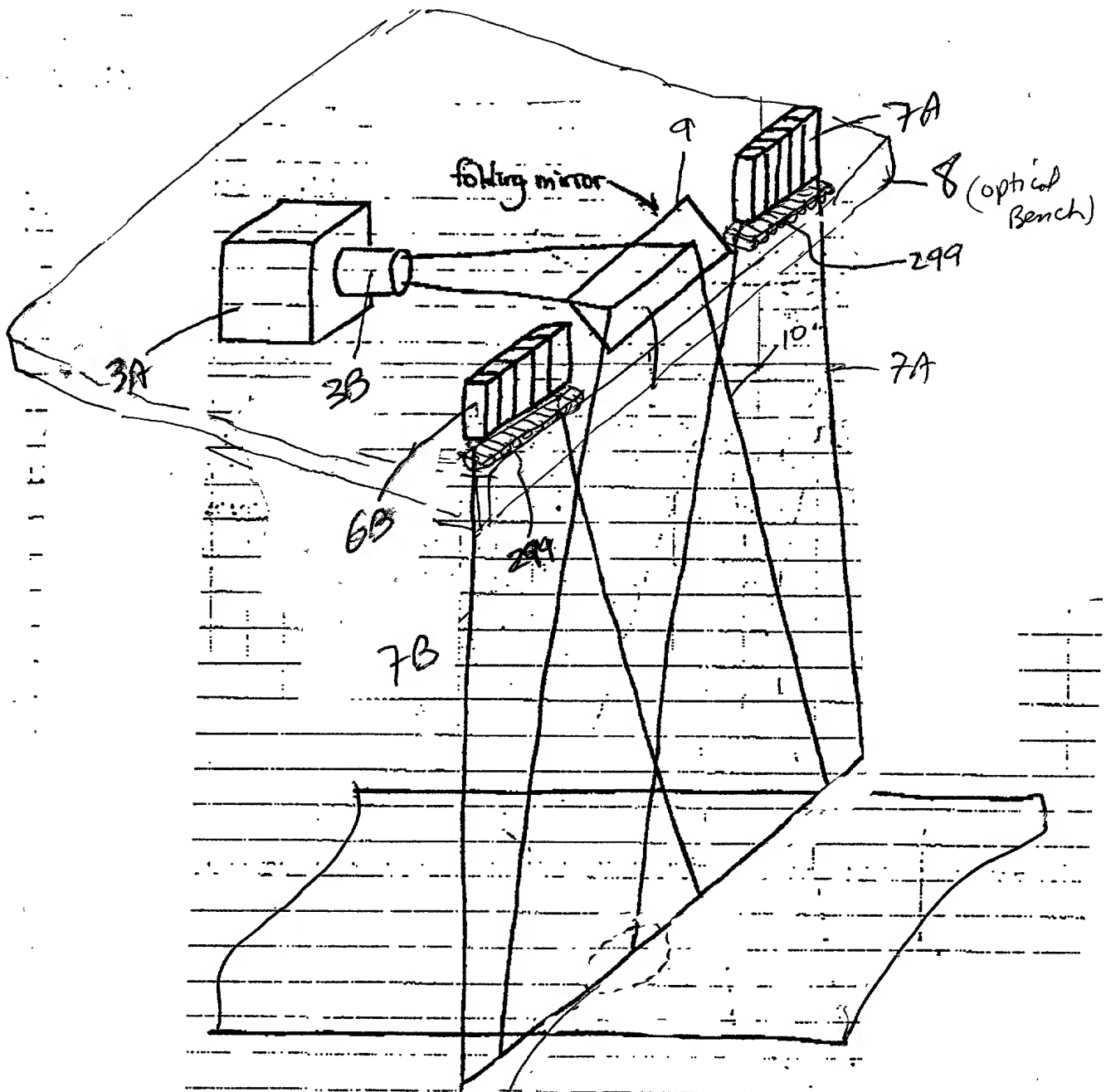
JC828 U.S. PTO
40/000000

10/067540



4 Moving Box
Code March

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1A

FIG 1B1

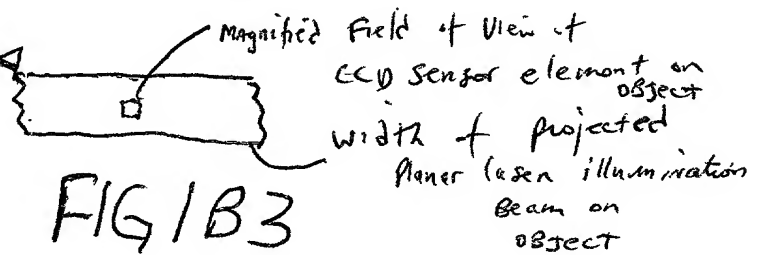


FIG 1B3

- (1) Fixed focal length camera lens
- (2) Fixed focal distance

Linear (1D) detector array

Module housing

Planar laser illumination beam undergoes micro-movement

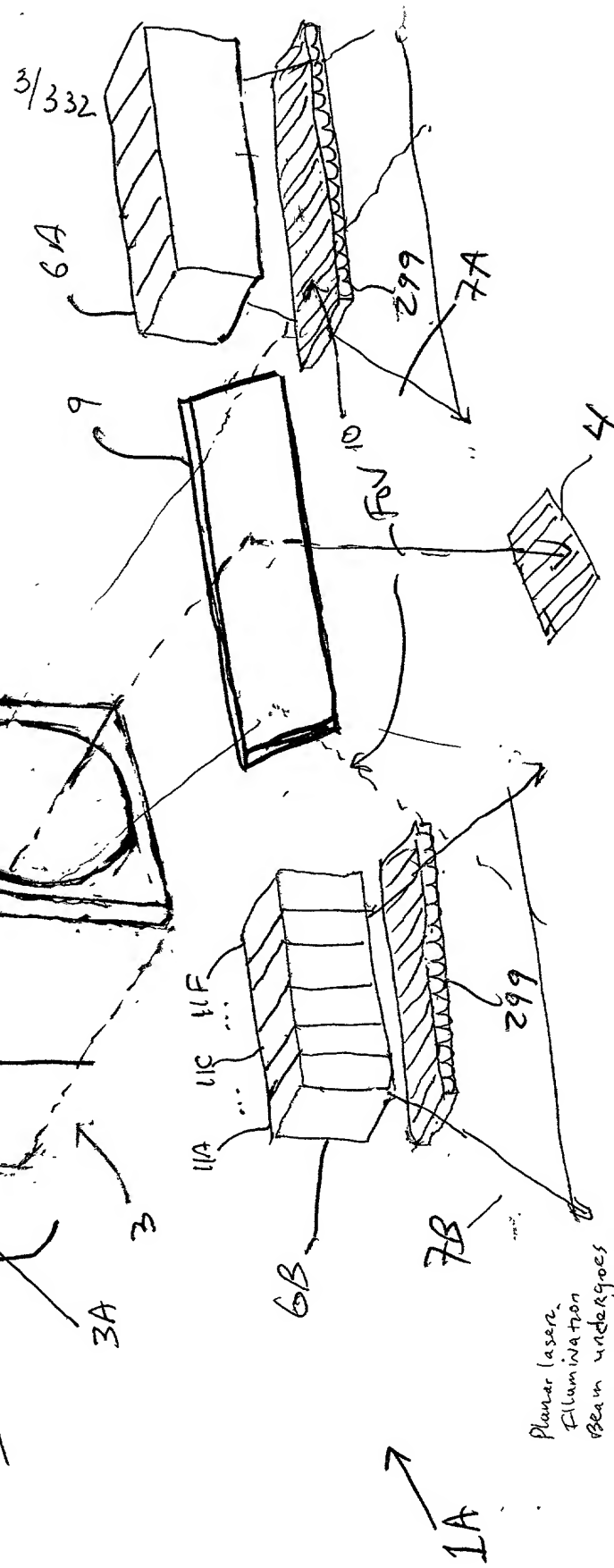
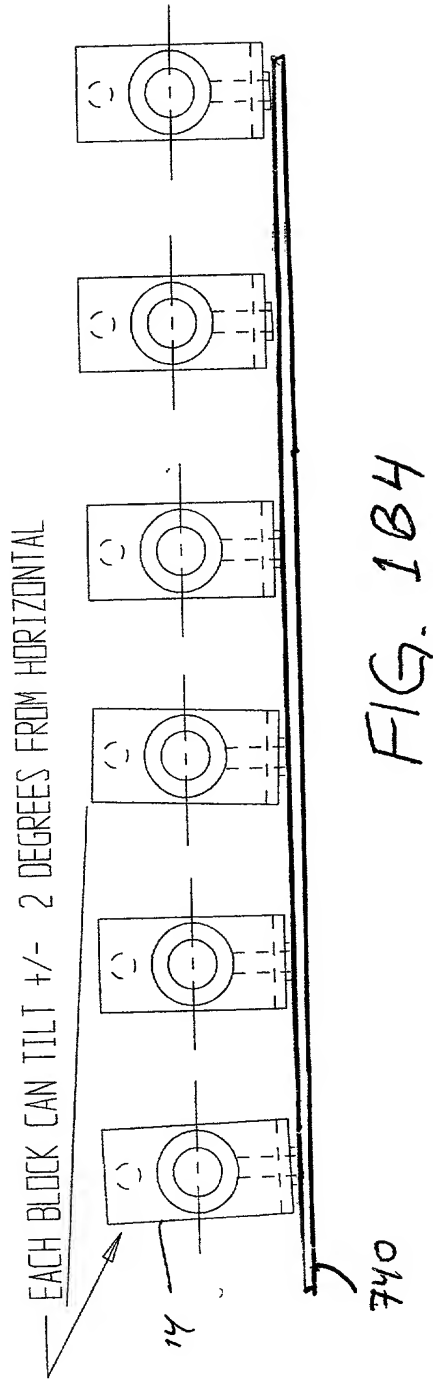
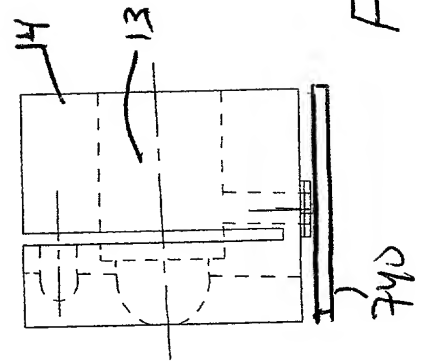


FIG. 1B2



VLD BLOCK CAN PITCH FORWARD FOR ALIGNMENT WITH OTHER VLD BEAMS



$$I(y_c) = \text{gaussian}$$

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Maximum
object
range

FIG. 1C



FIG. 1E1

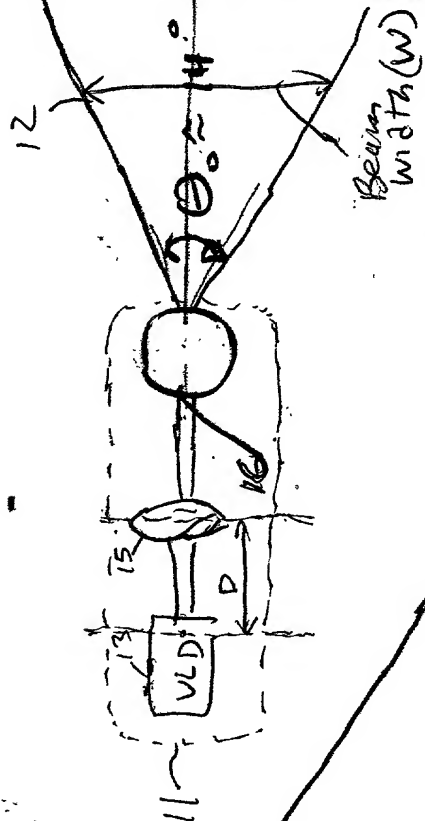


FIG. 1D

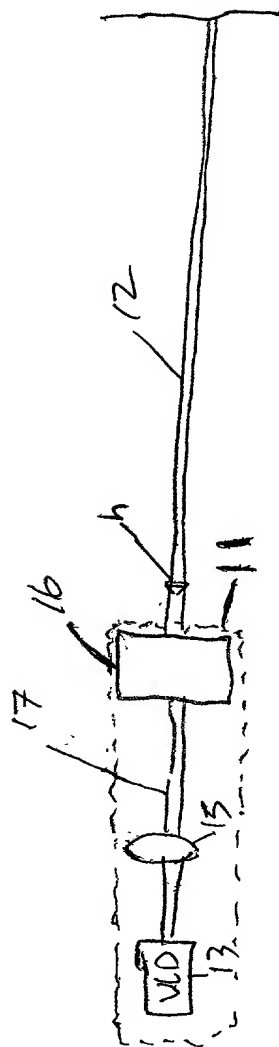
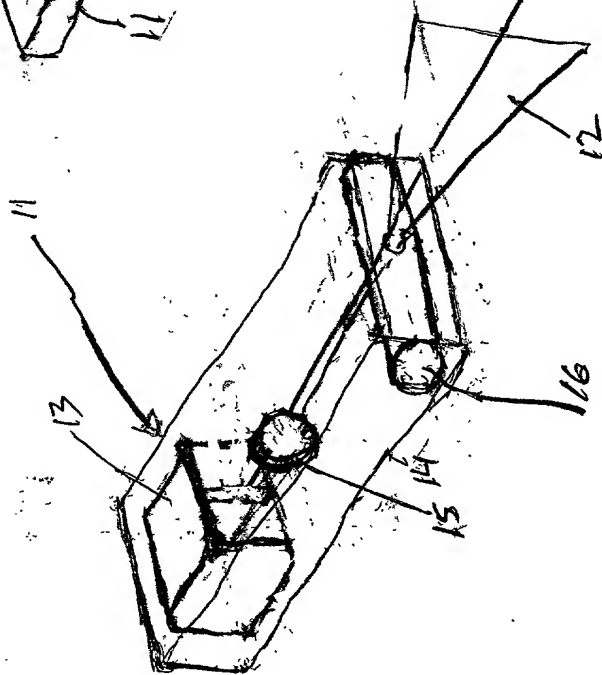


FIG. 1E2

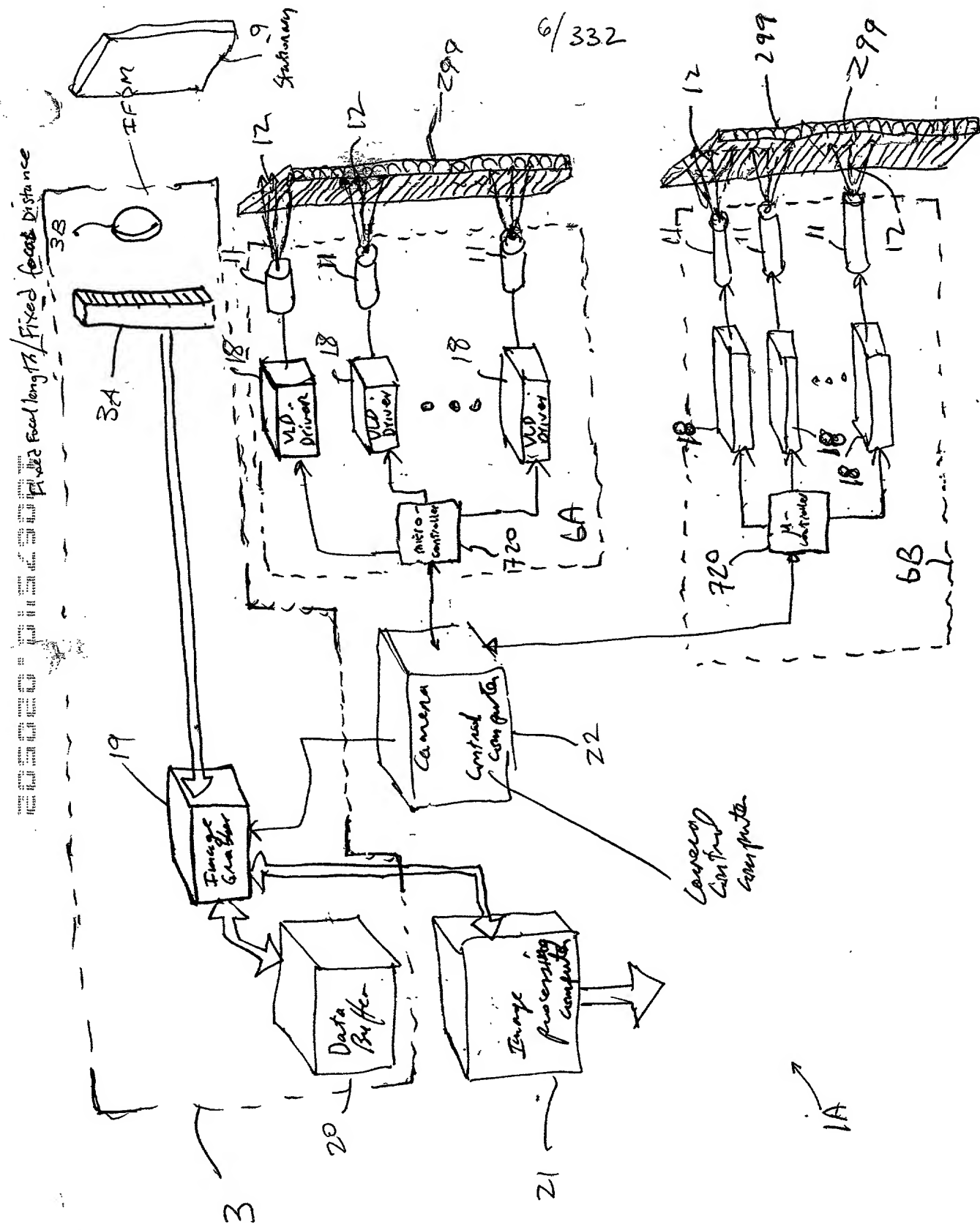


FIG. 1F

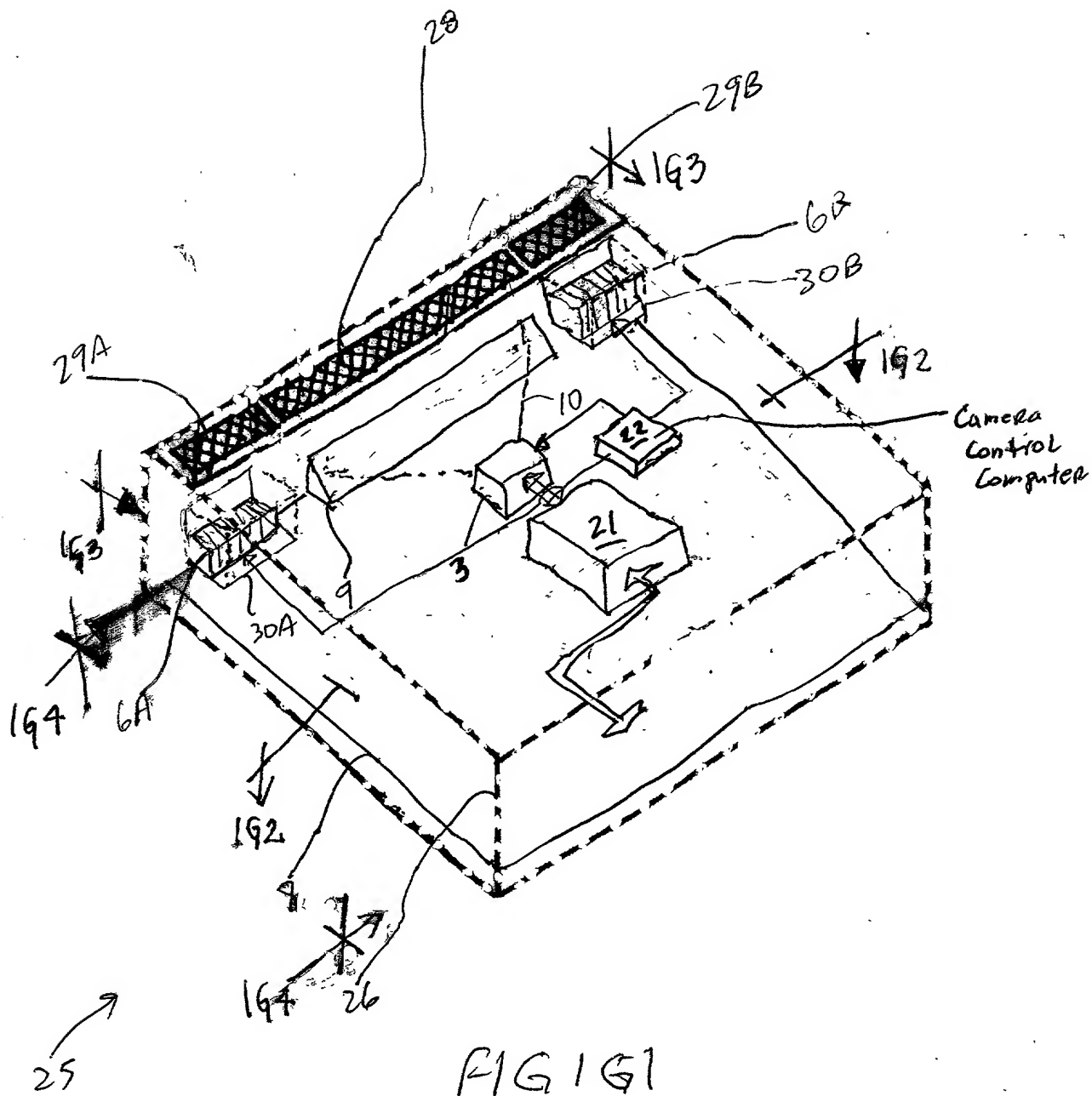


FIG 1G1

8/ 332

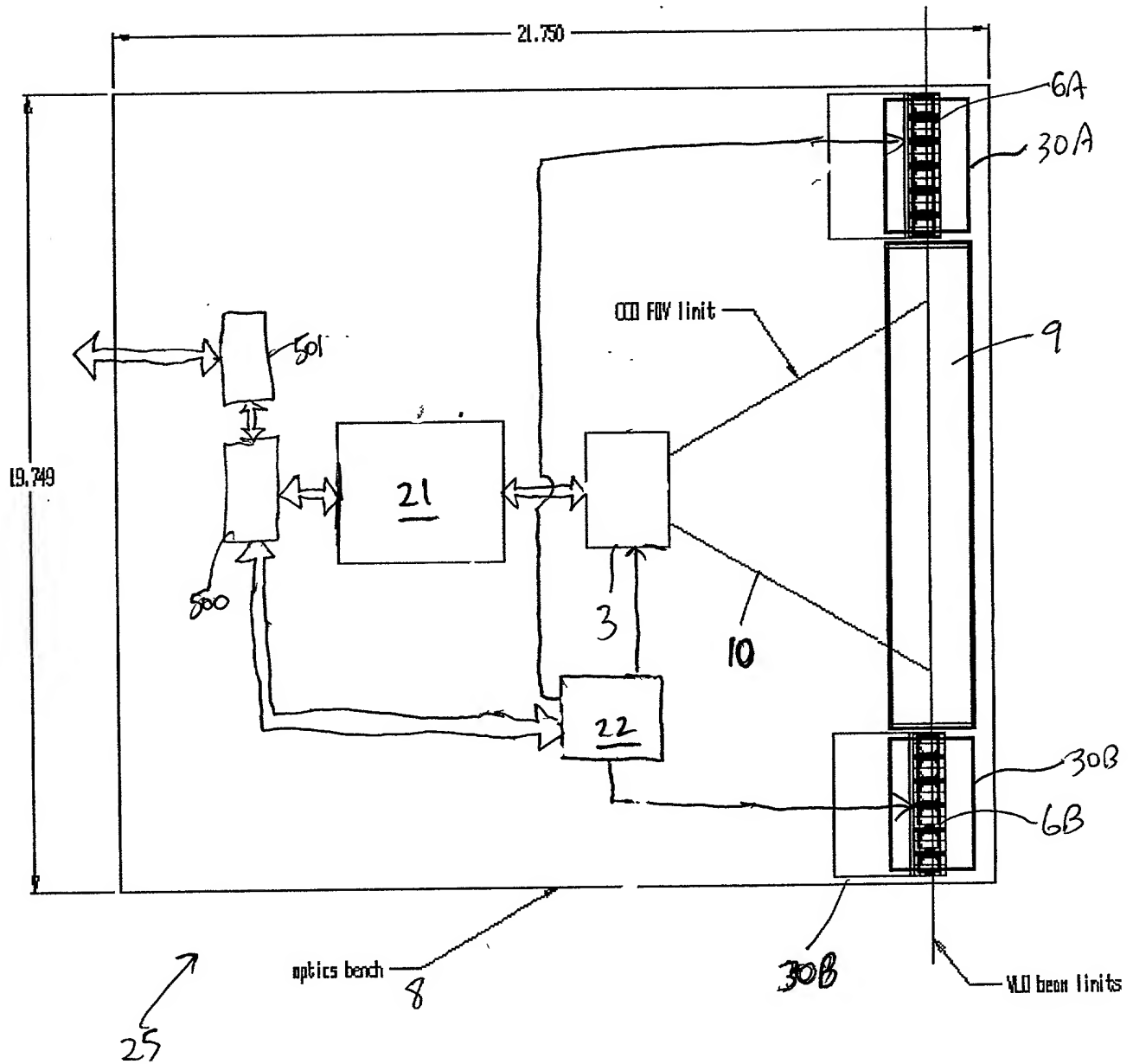


FIG. 162

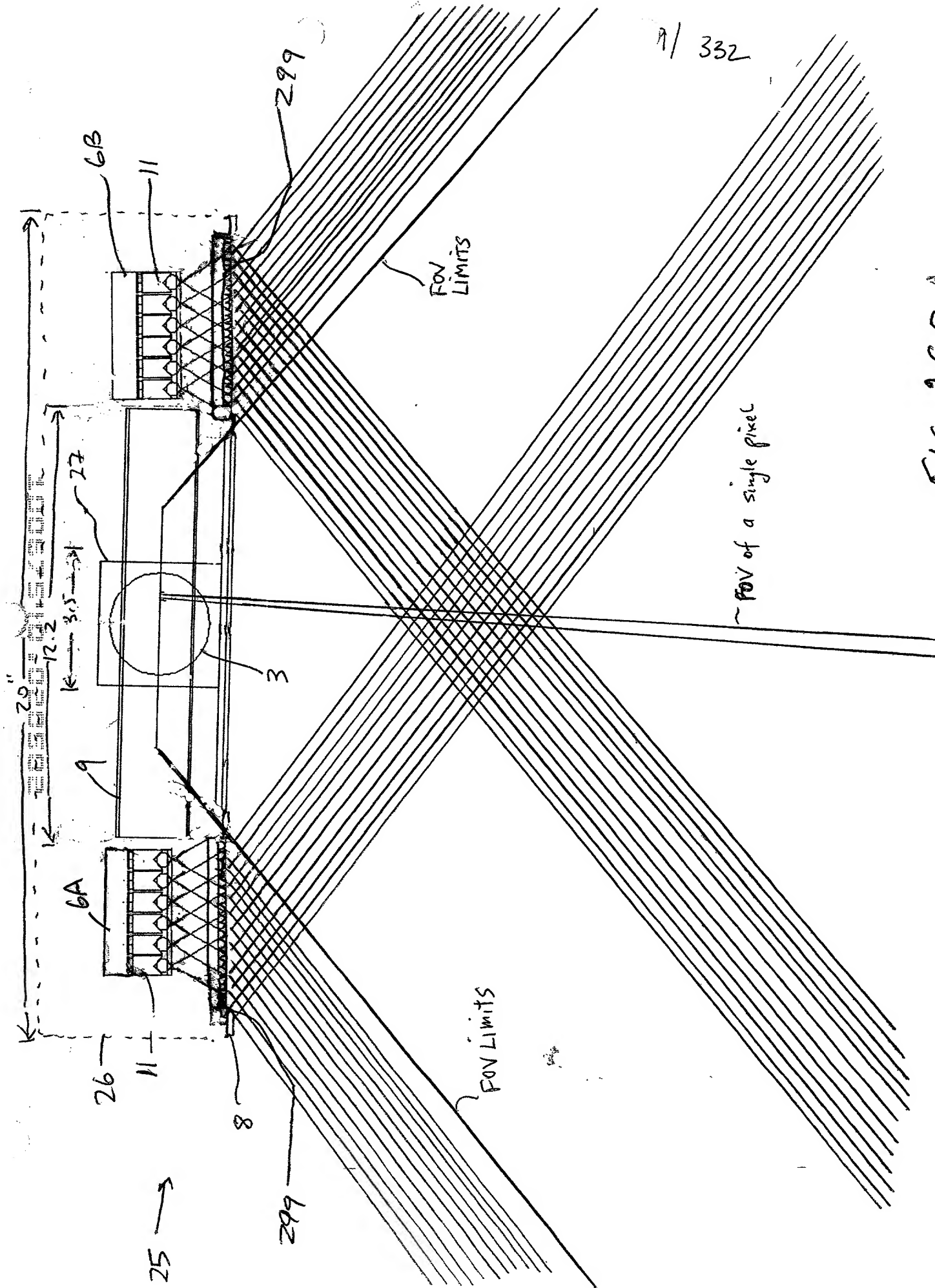


FIG 1G3.

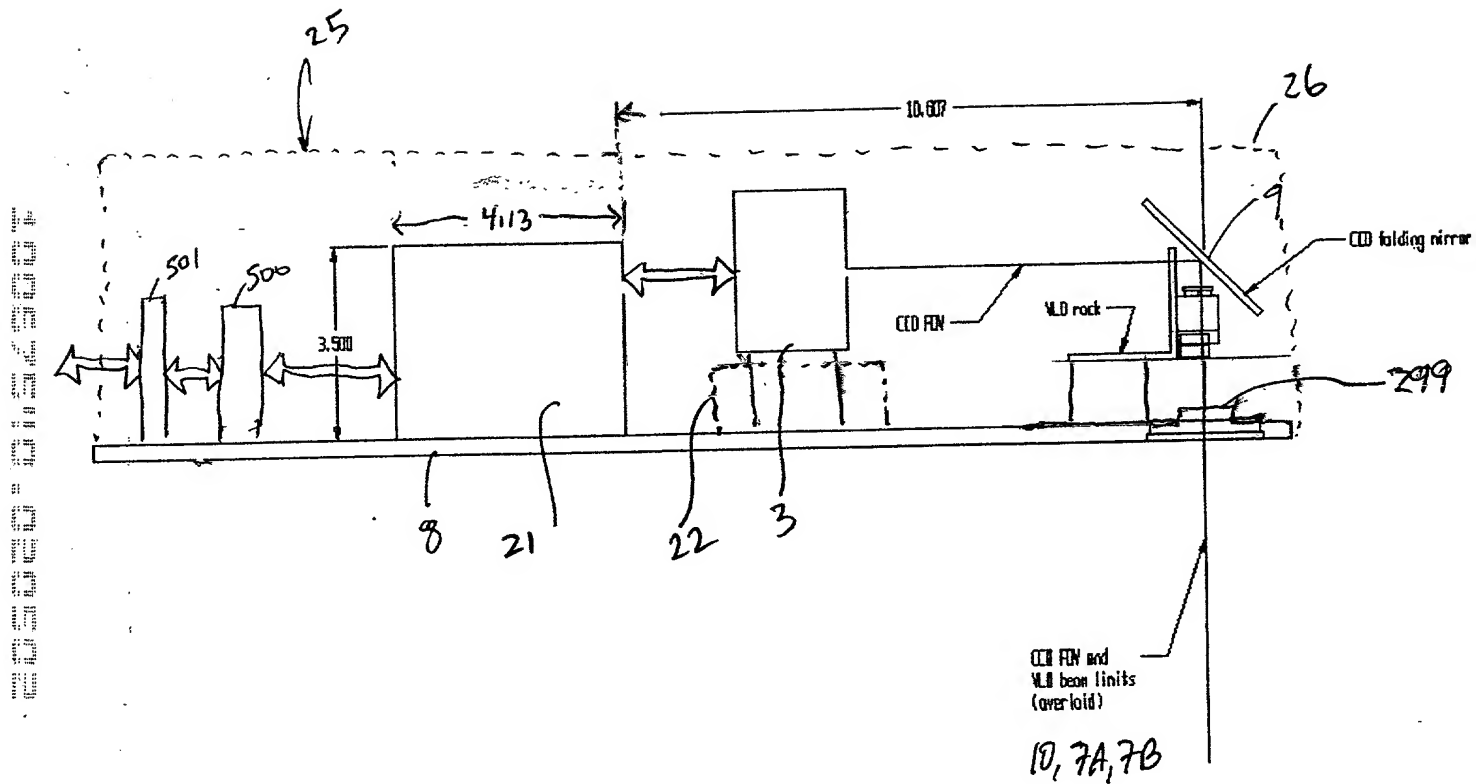
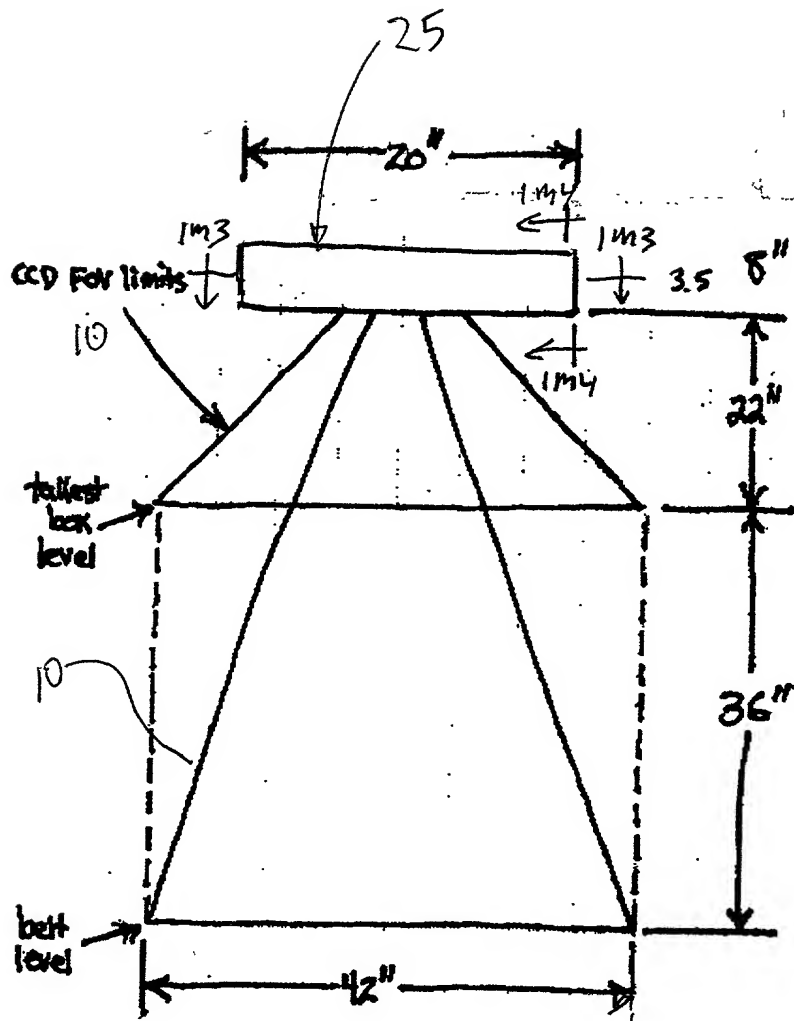


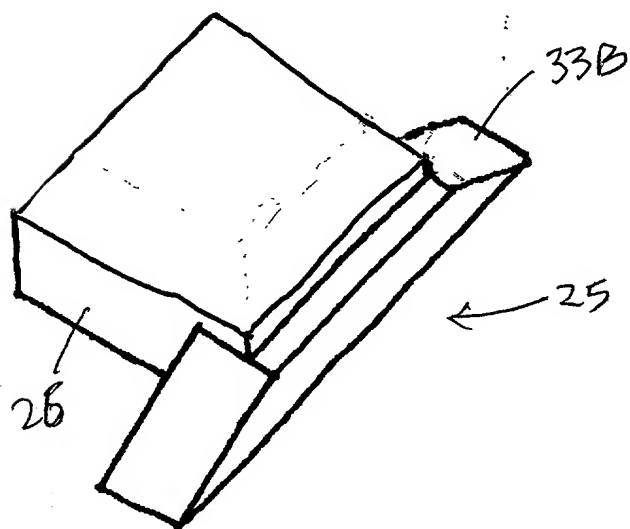
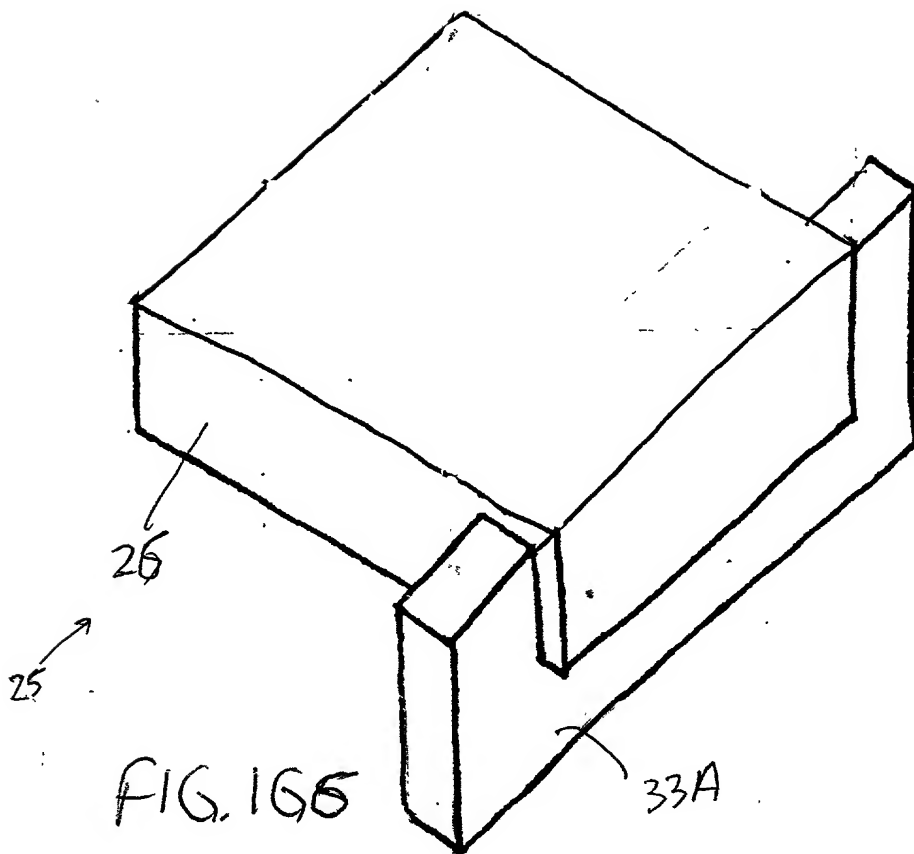
FIG. 164

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* Fixed Field of Field

FIG. 145



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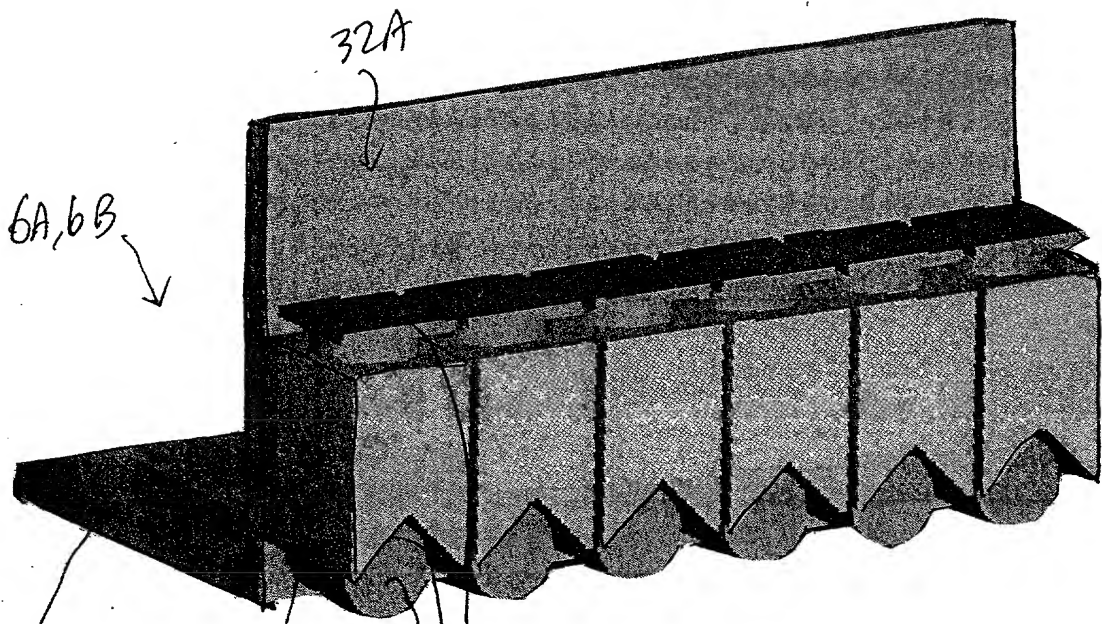


FIG. 1G 8

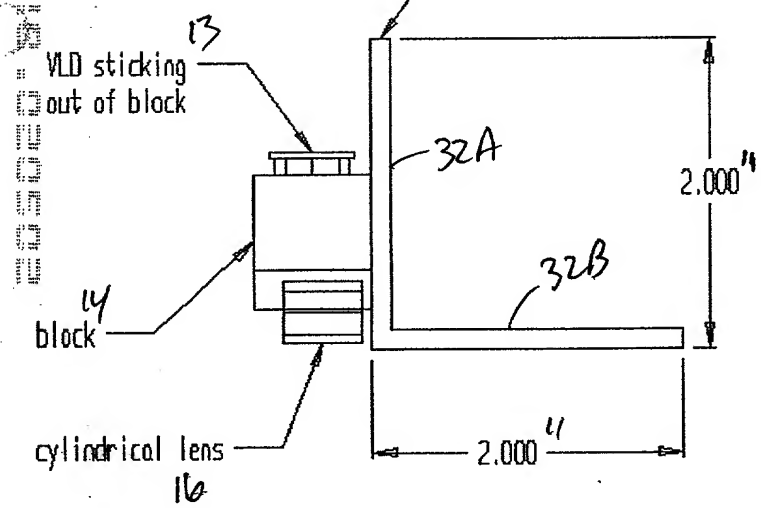


FIG. 1G.9

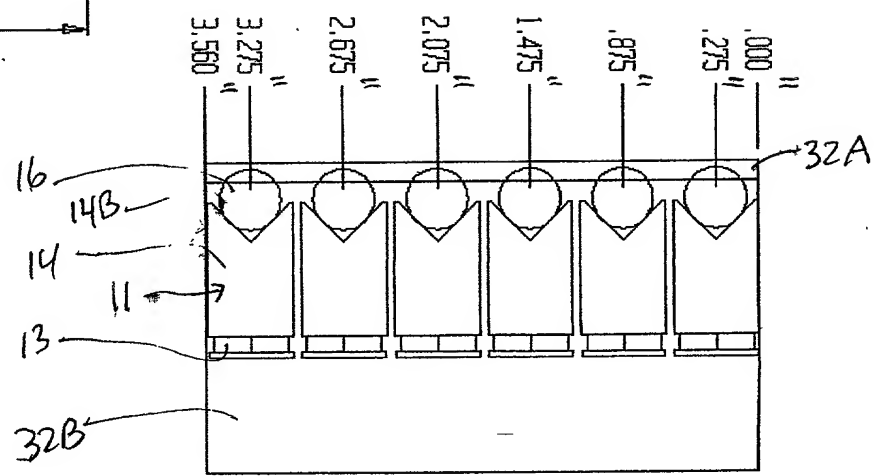


FIG. 1G10

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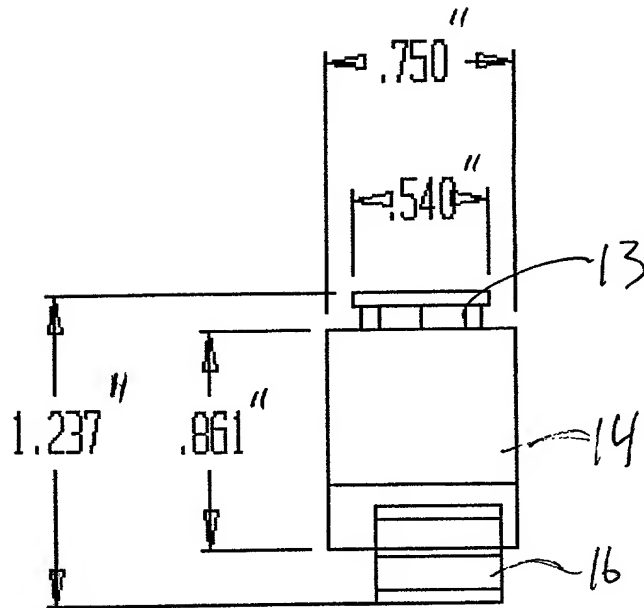


FIG. 1611

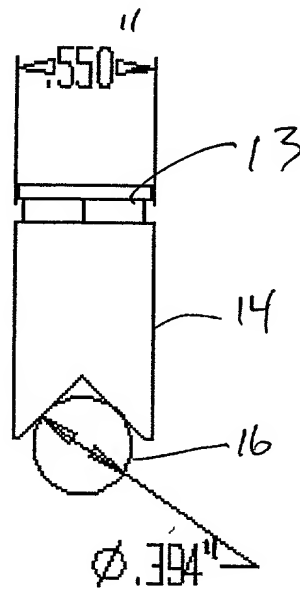


FIG. 1612

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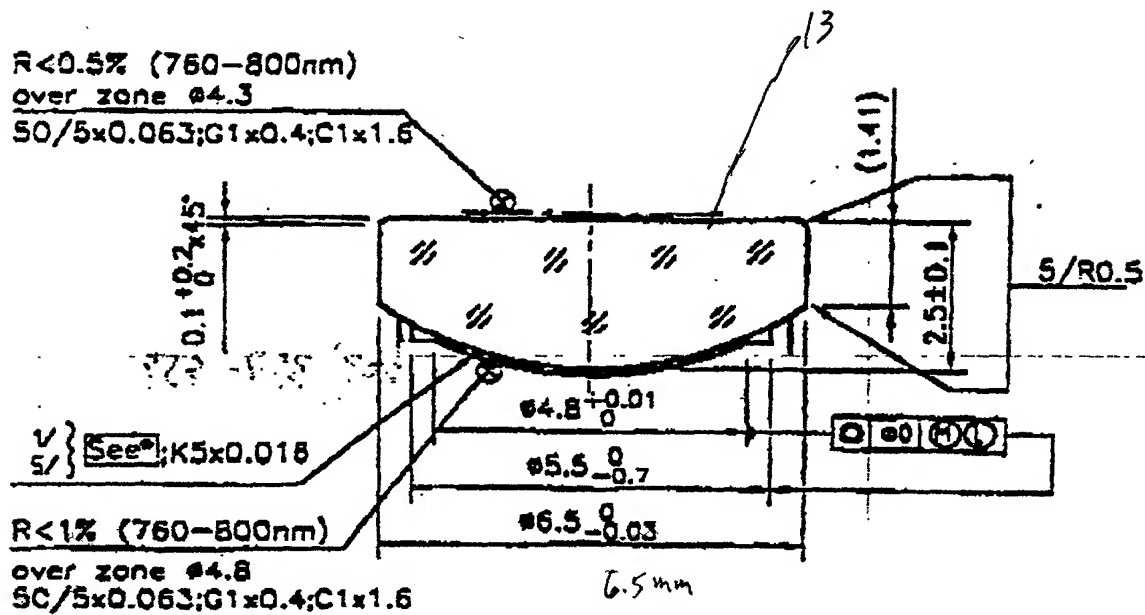


FIG. 1G13

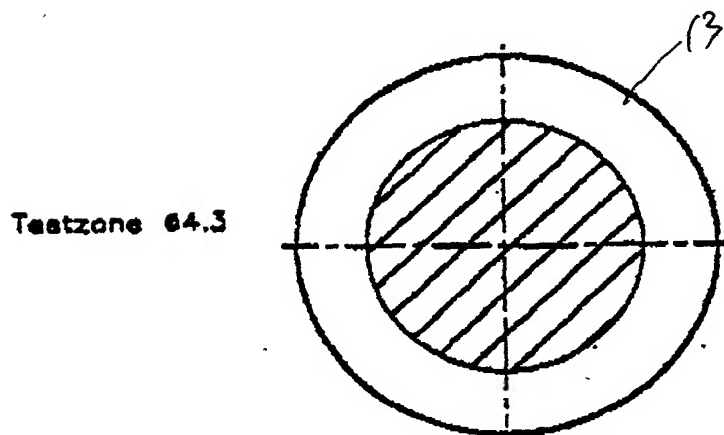


FIG. 1G14

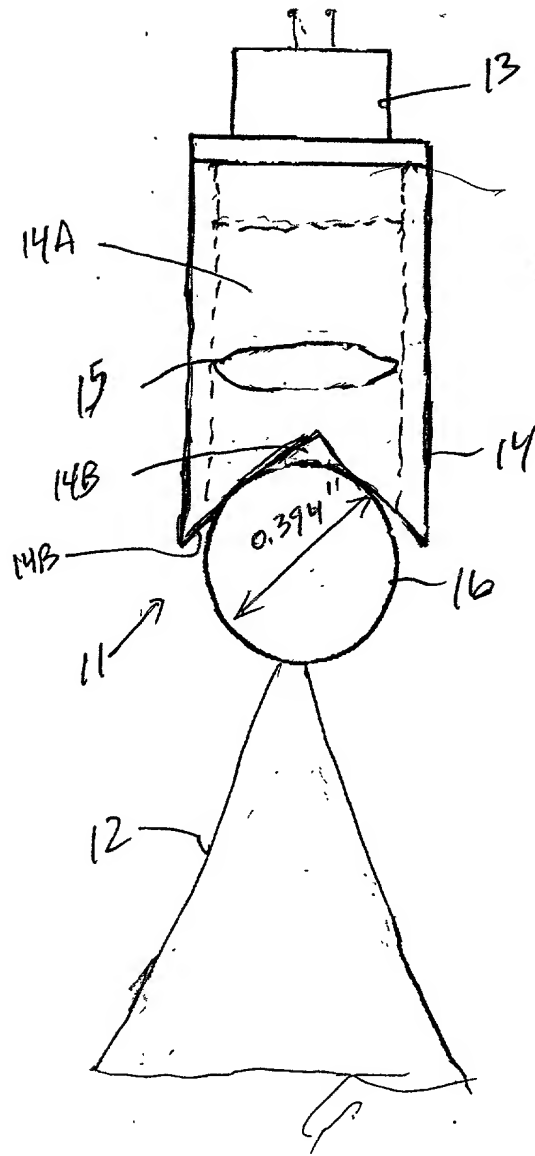


FIG. 1G15A

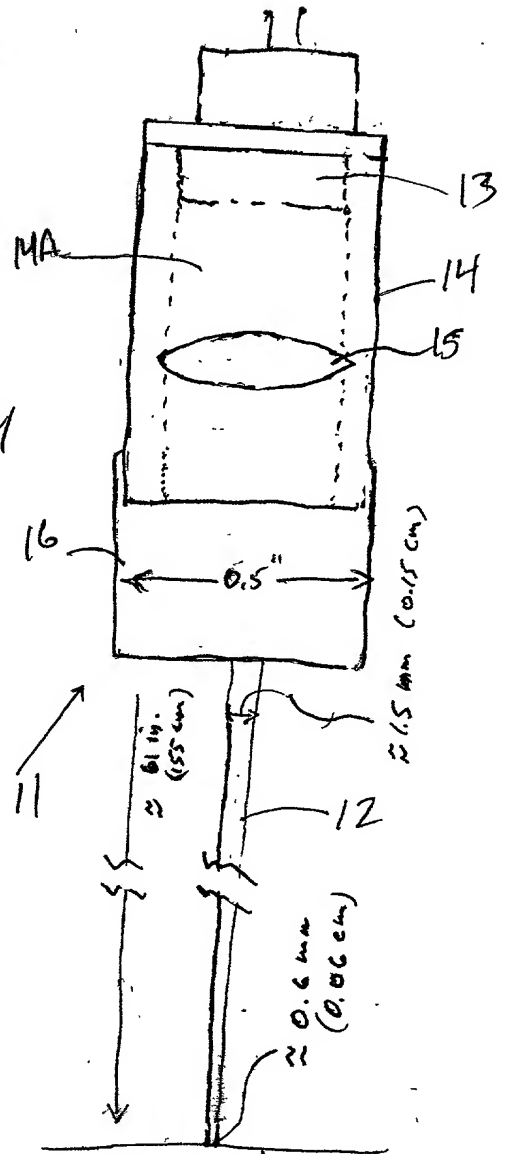


FIG. 1G15B

furthest
object/working
distance

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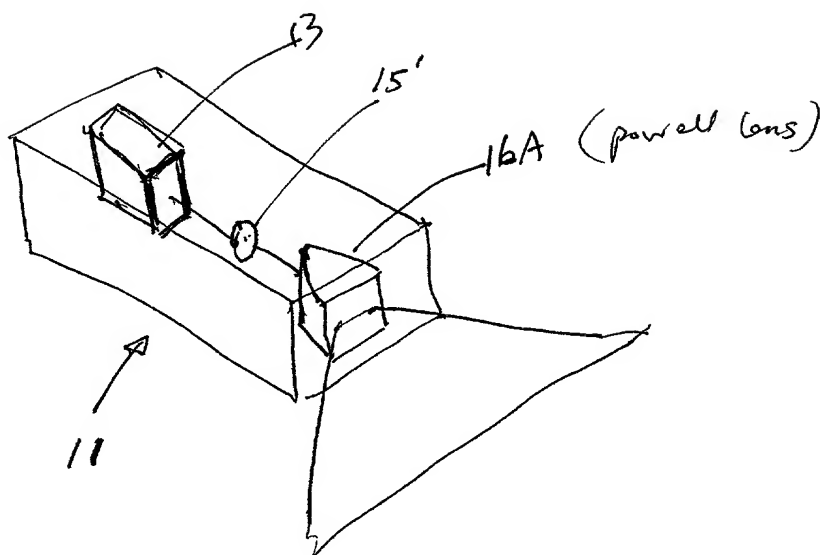


FIG. 1G.16A

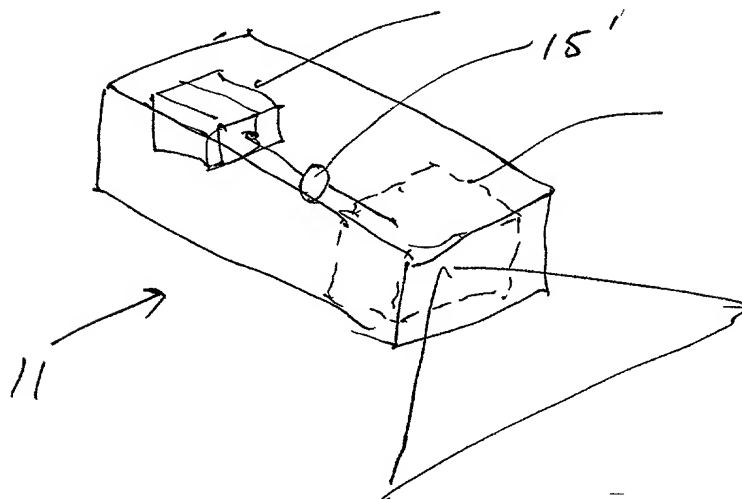


FIG. 1G.16B

PLIM w/
powell lens

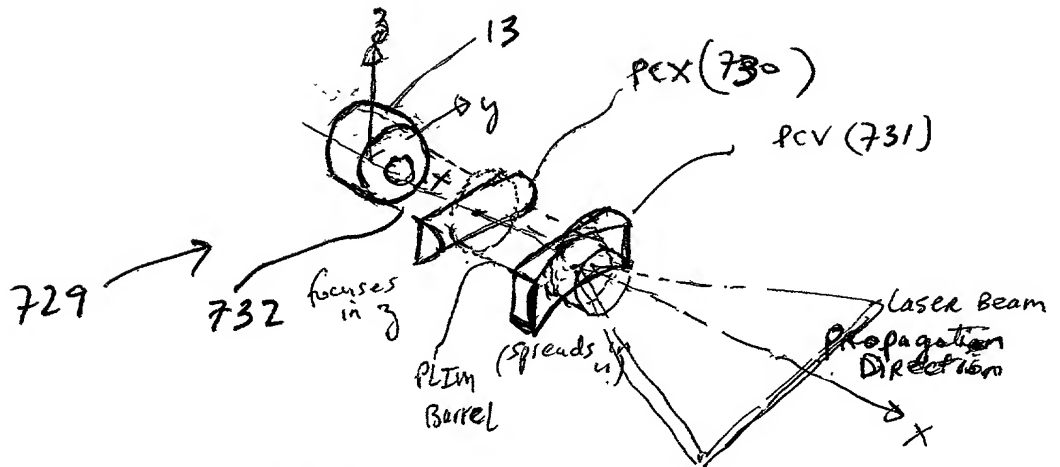


FIG. 16.17A

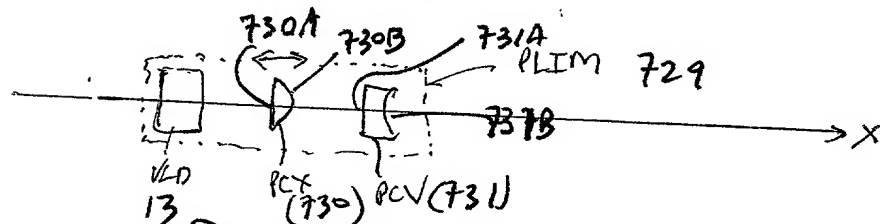


FIG. 16.17B

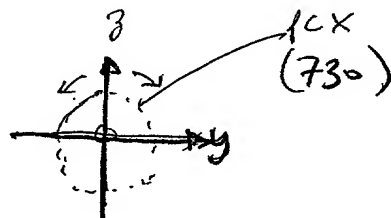


FIG. 16.17C

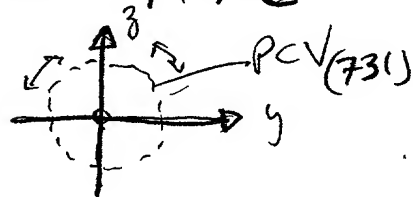


FIG. 16.17D

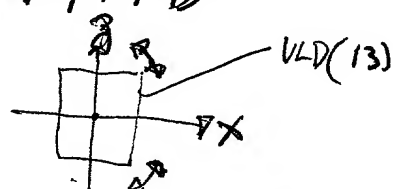


FIG. 16.17E

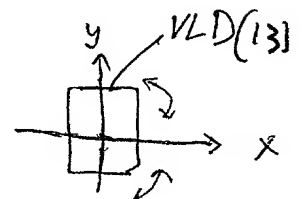
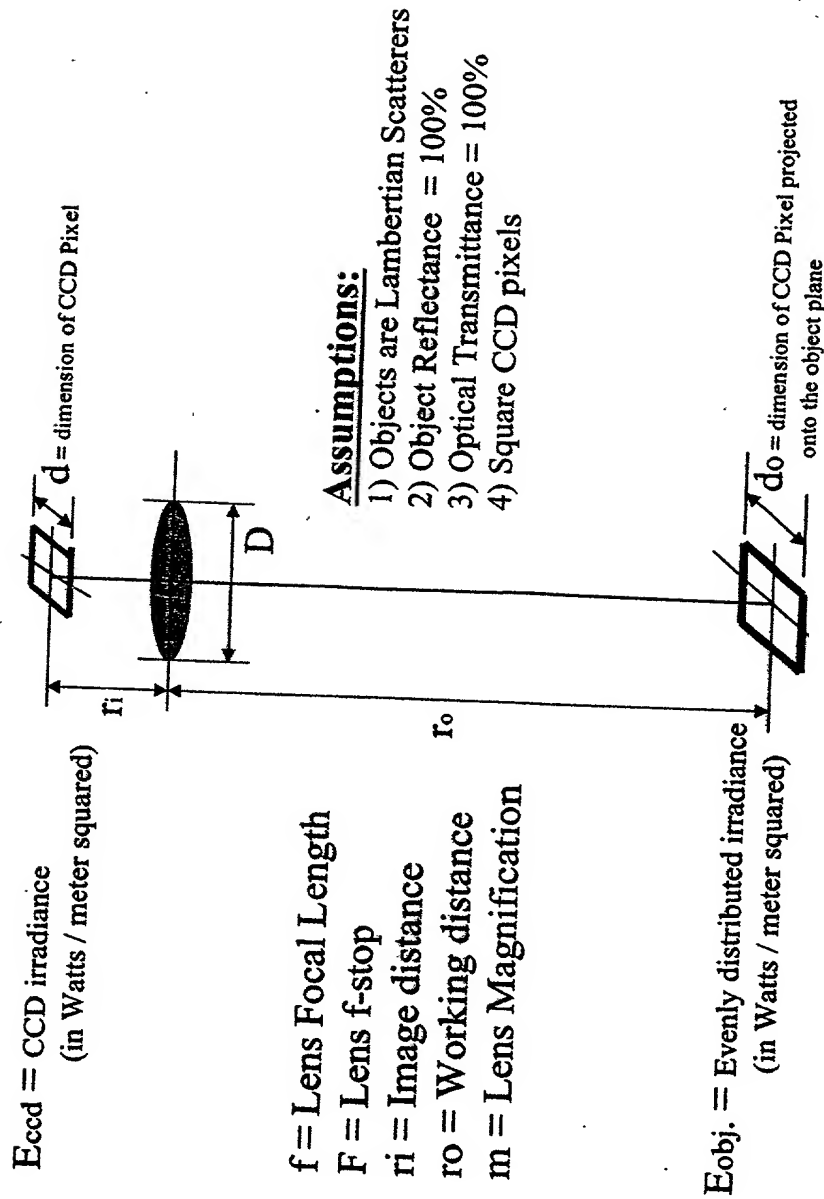


FIG. 16.17F

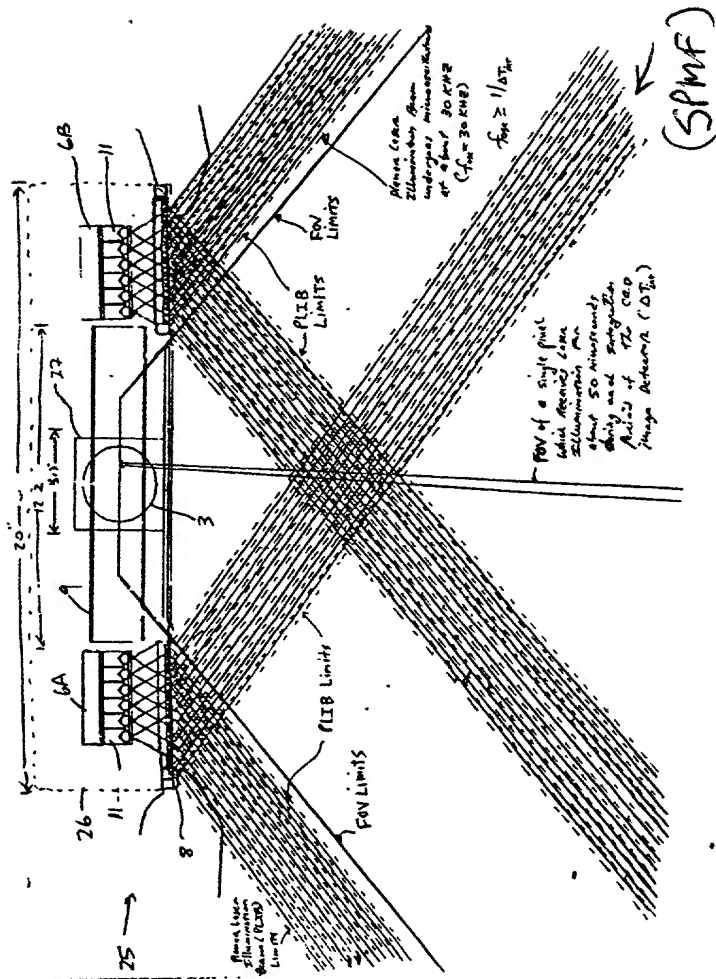
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CCD-Based Scanner

FIG. 1H6

FIRST GENERALIZED METHOD
of Reducing Speckle-noise
PATTERNS AT IMAGE
Detection array of the
FFD subsystem (3)



Prior to object illumination

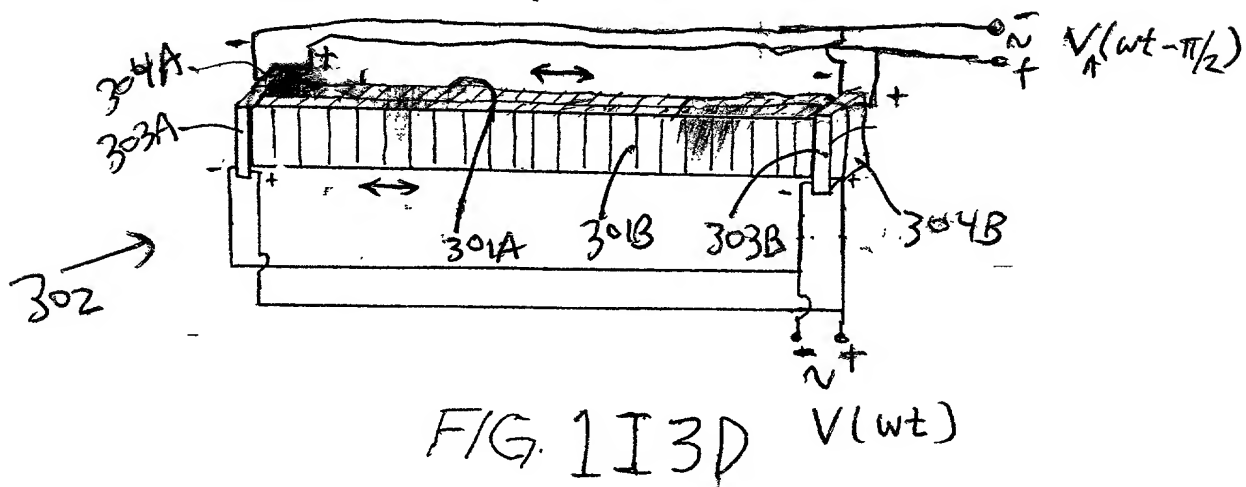
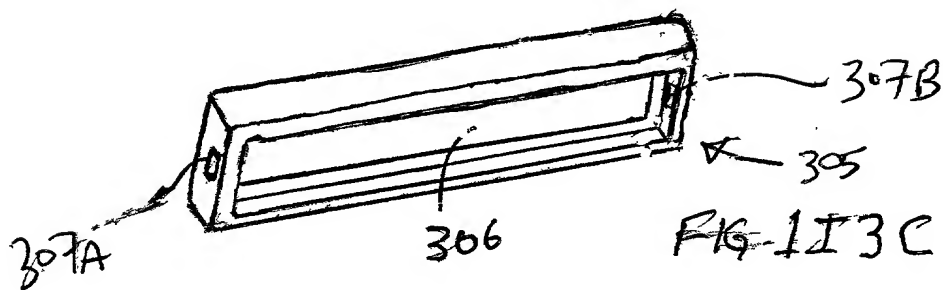
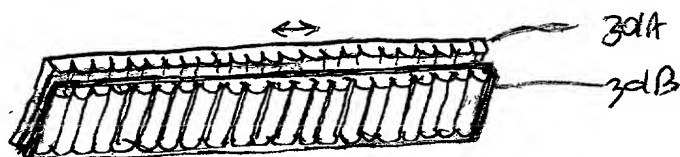
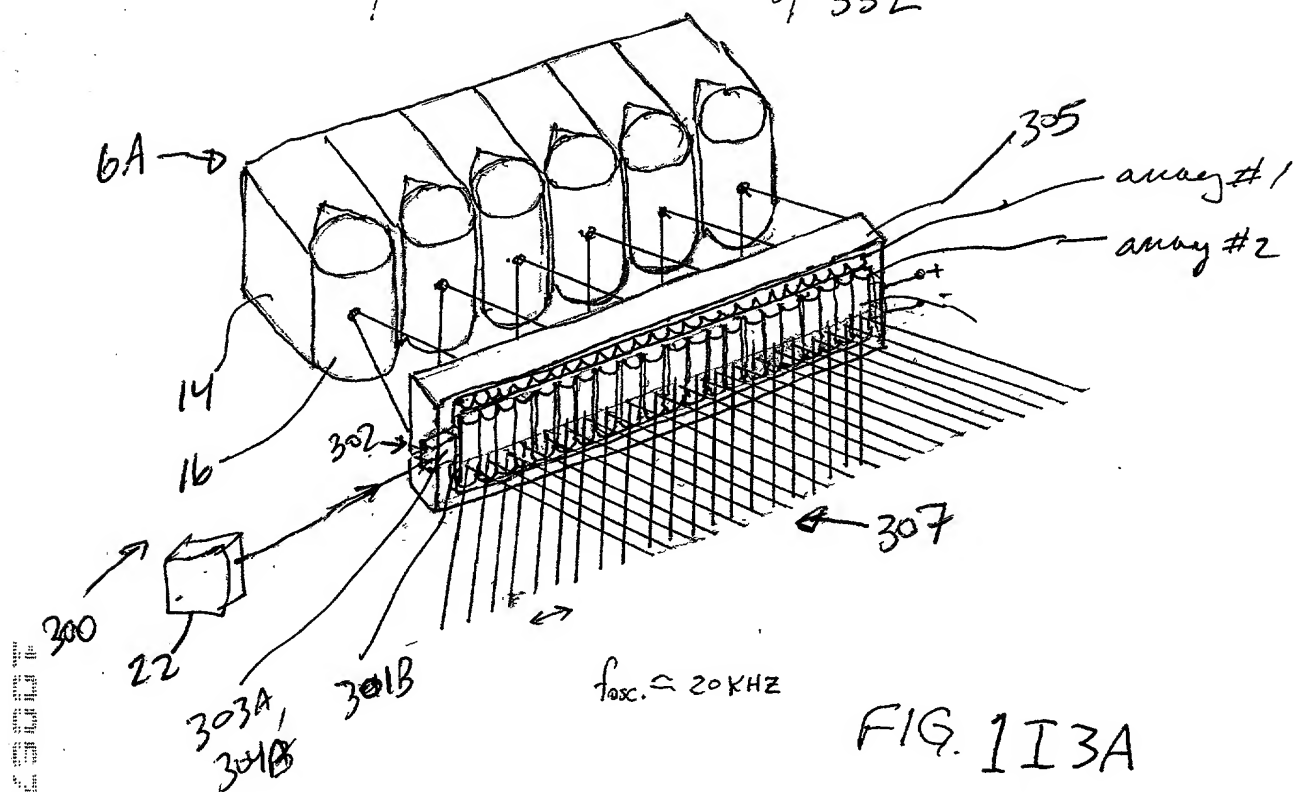
FIG. 1 I 2 A

The First Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial phase of the transmitted PLIB along the planar extent thereof according to a spatial phase modulation function (SPMF) so as to produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the power of the speckle-noise pattern observed at the image detection array.

FIG. 1I2B



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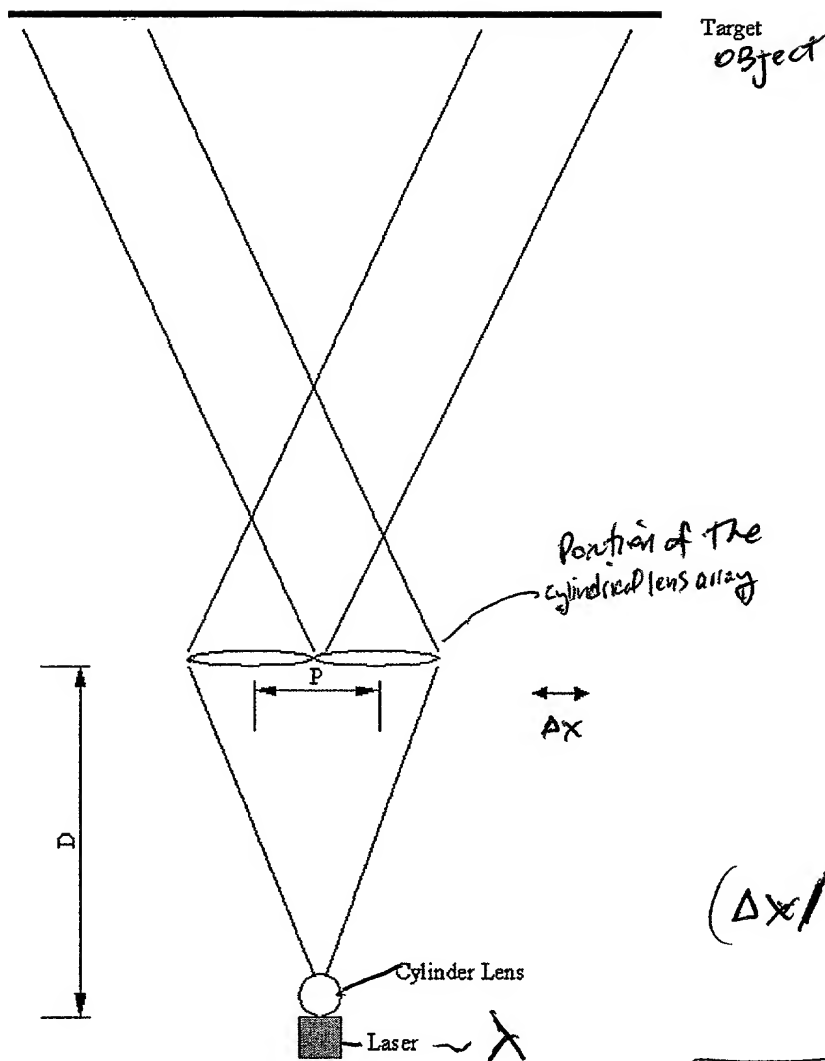


Figure 1

$$(\Delta x / D) P = \lambda$$

$$\Delta x \geq \frac{\lambda \cdot D}{P}$$

FIG. 1I3E

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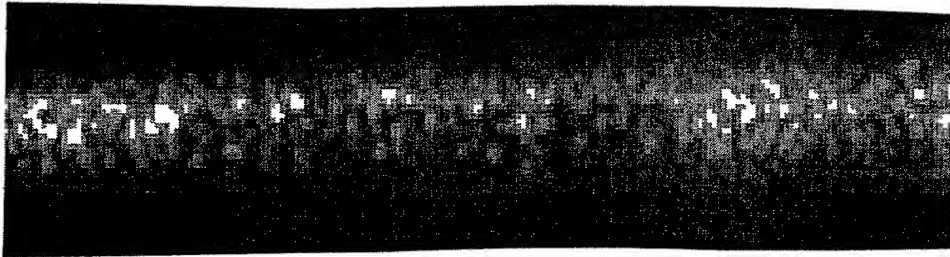


FIG. 1I3F



FIG 1I3G

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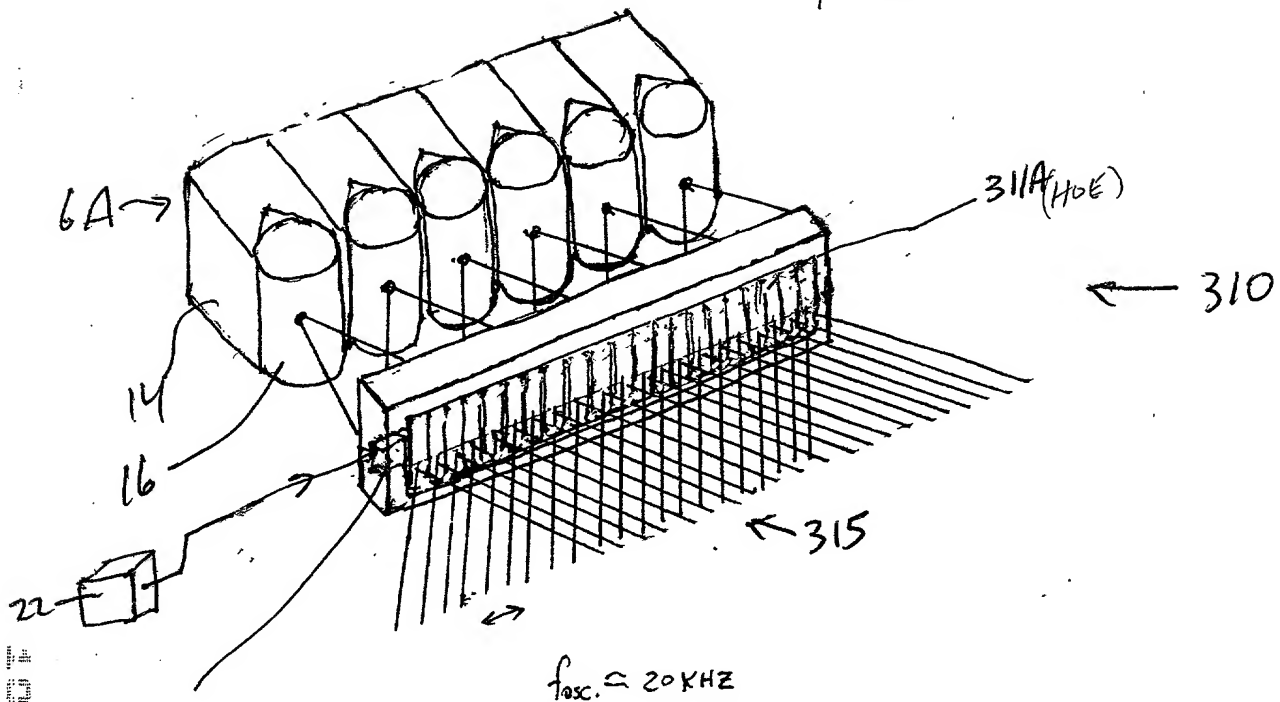


FIG. 1I4A

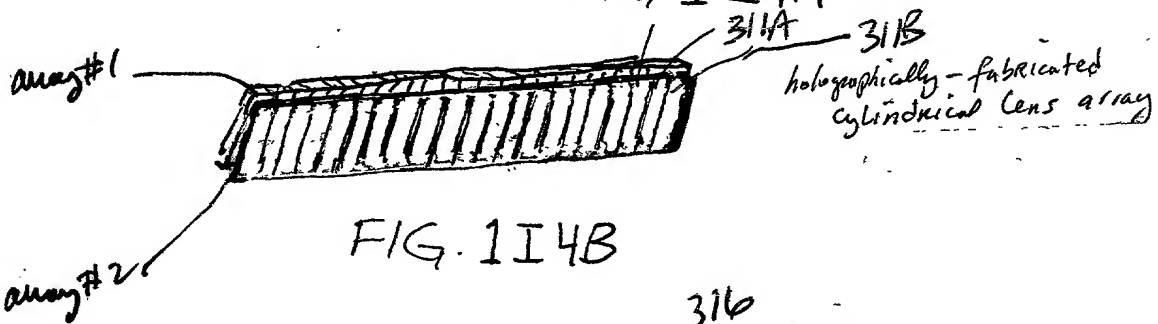


FIG. 1I4B

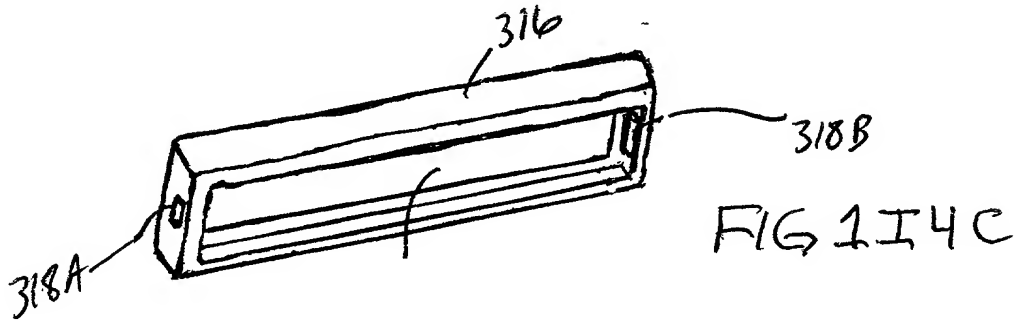


FIG. 1I4C

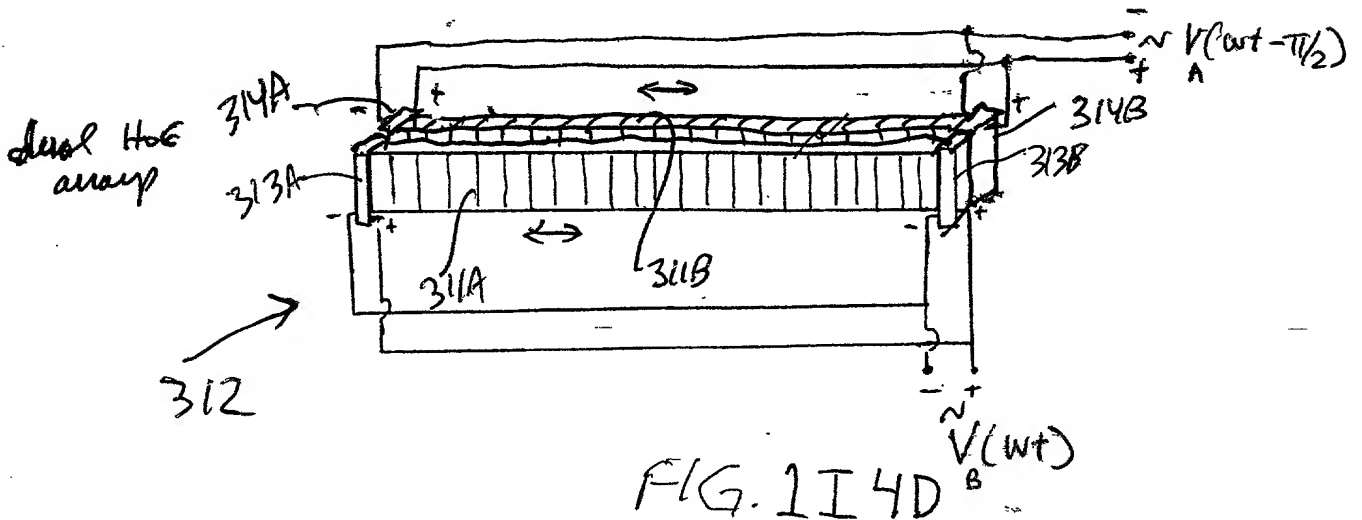
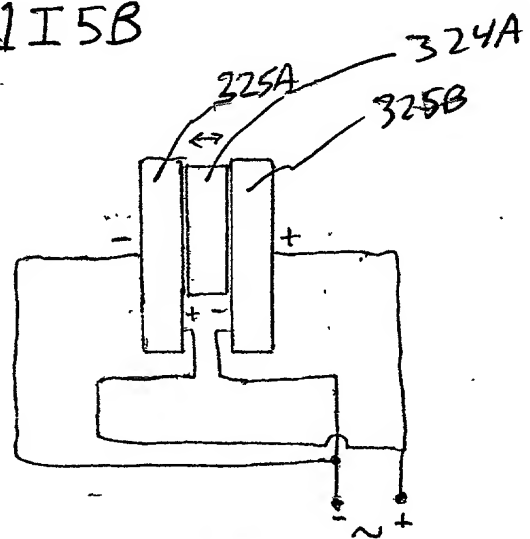
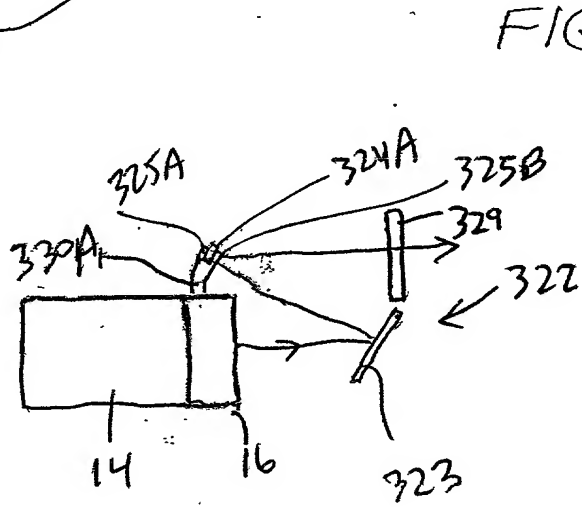
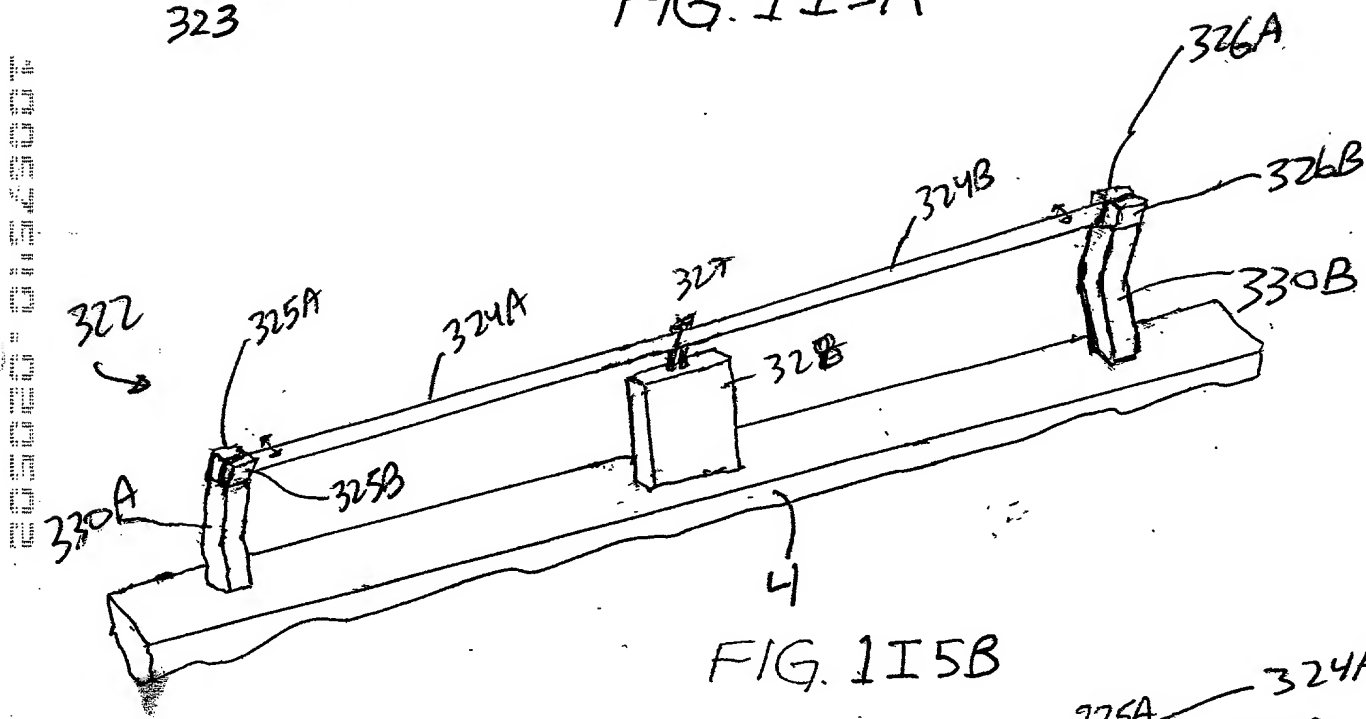
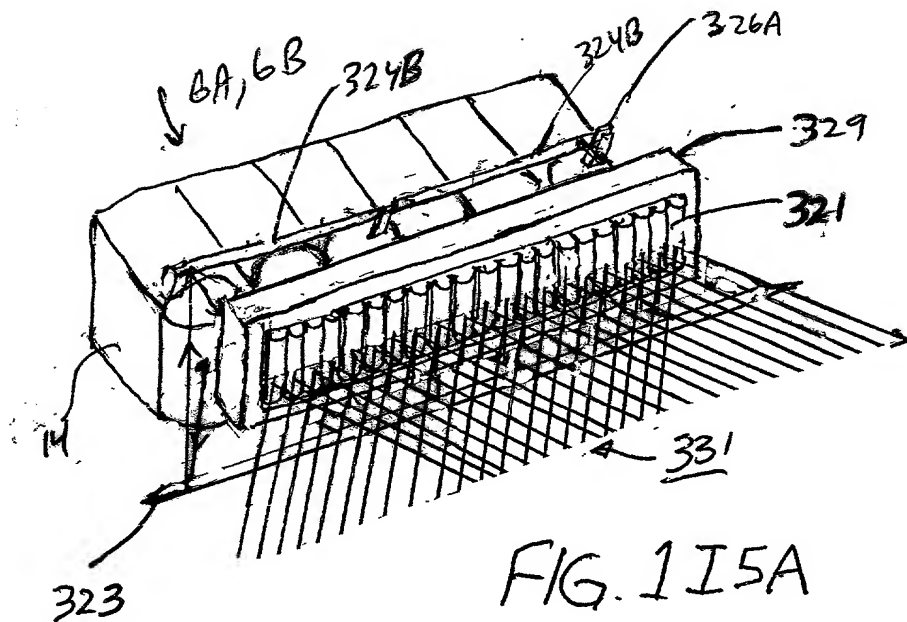
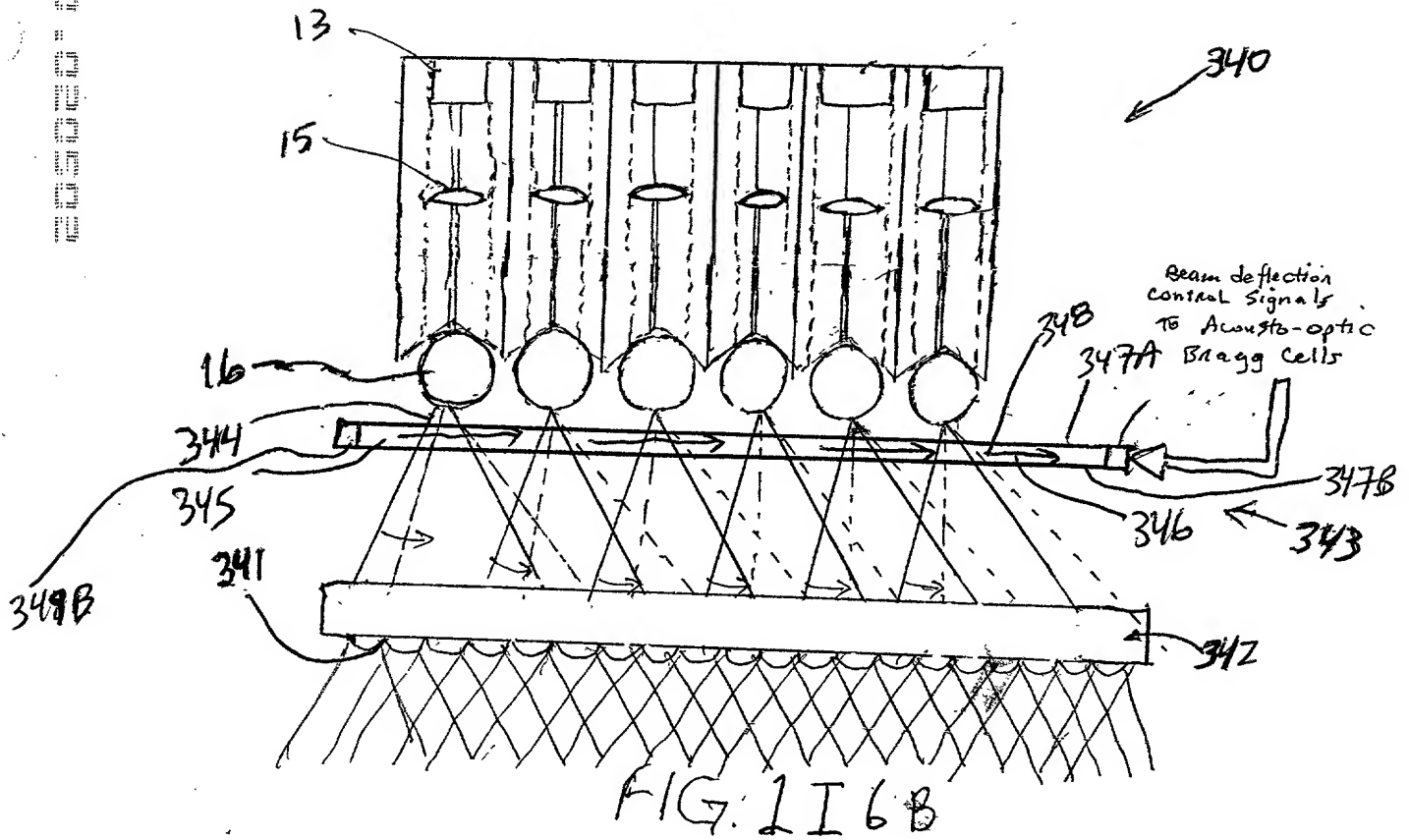
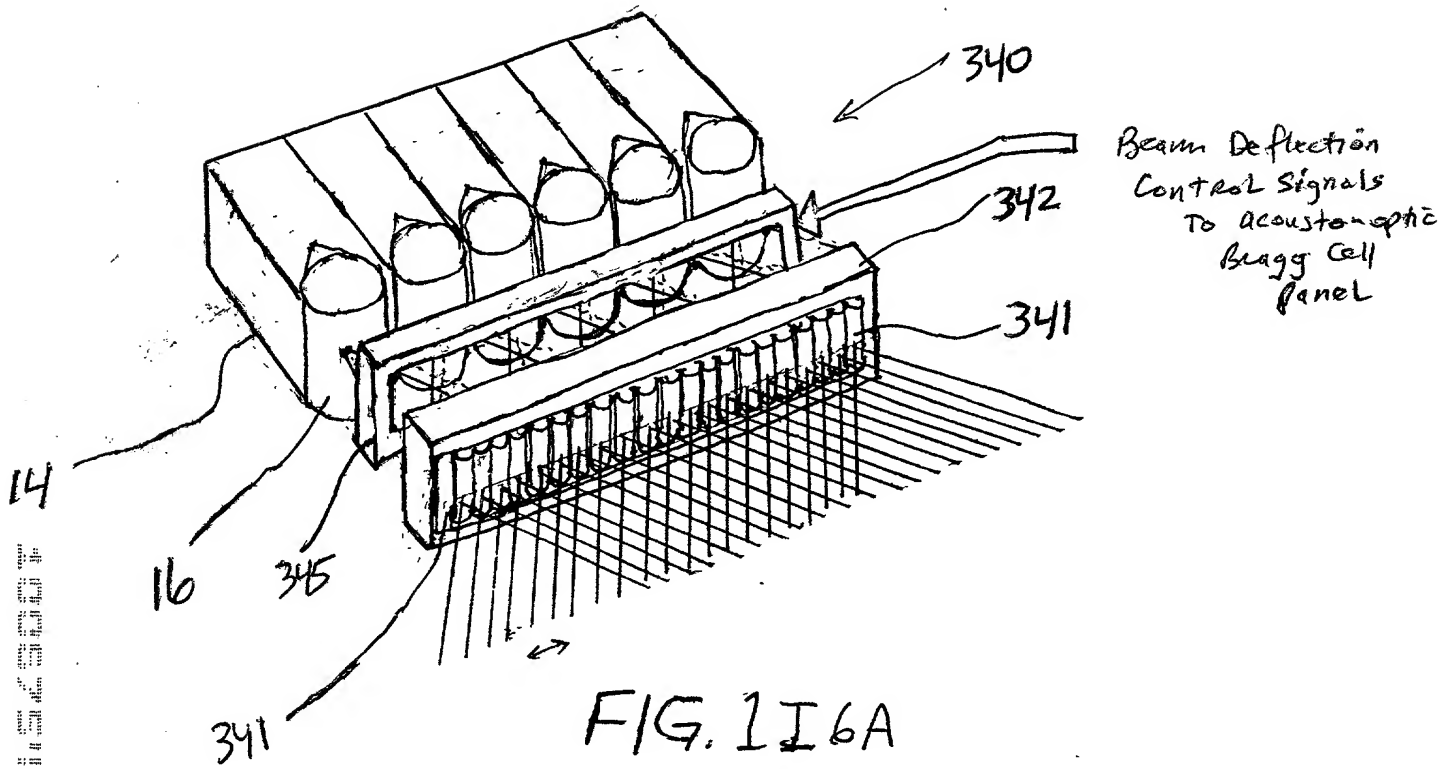


FIG. 1I4D





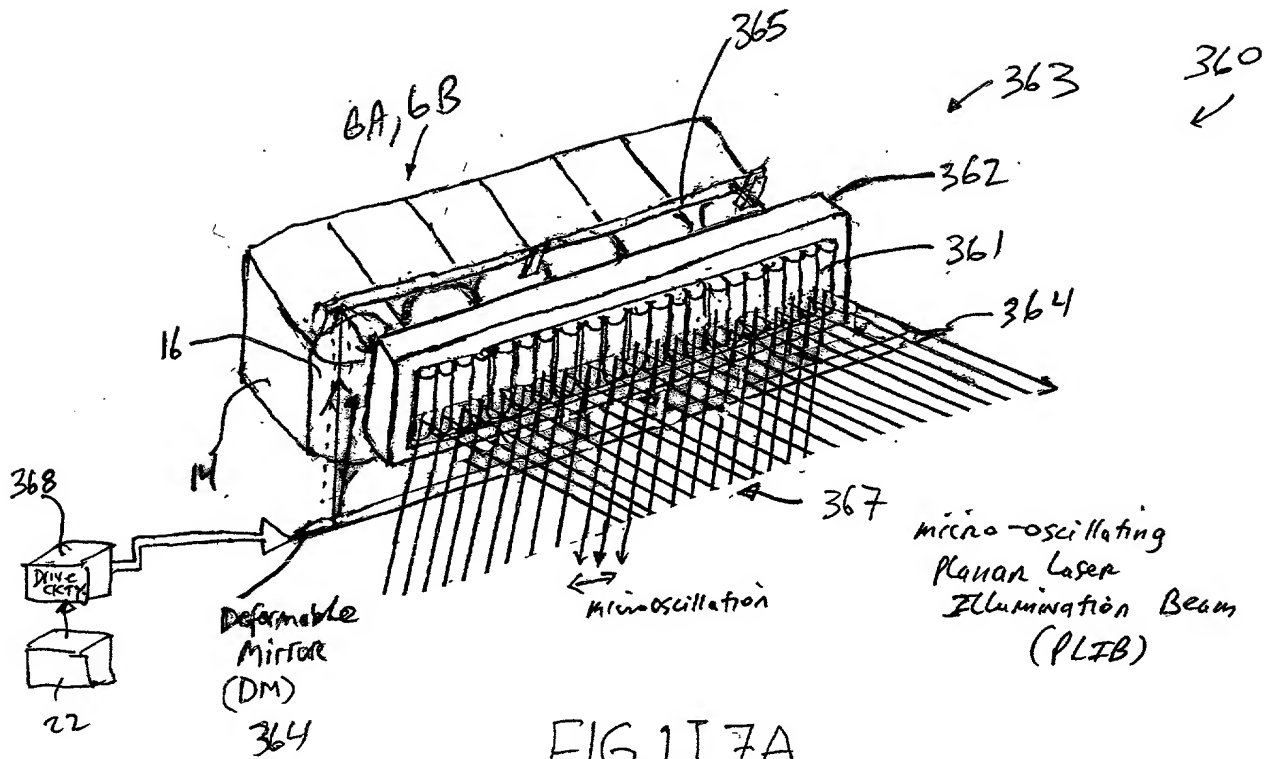


FIG. 1I7A

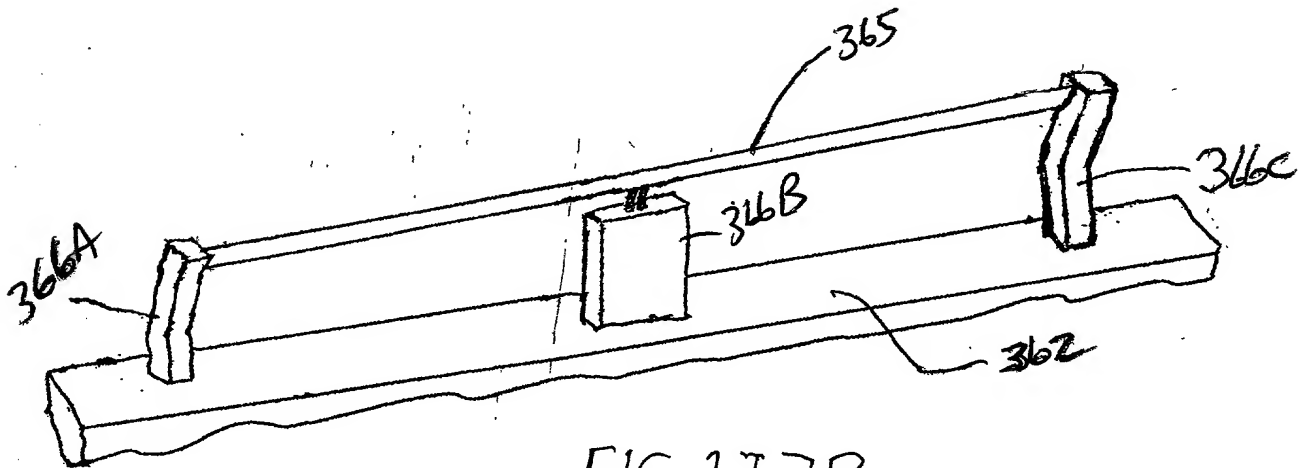


FIG. 1I7B

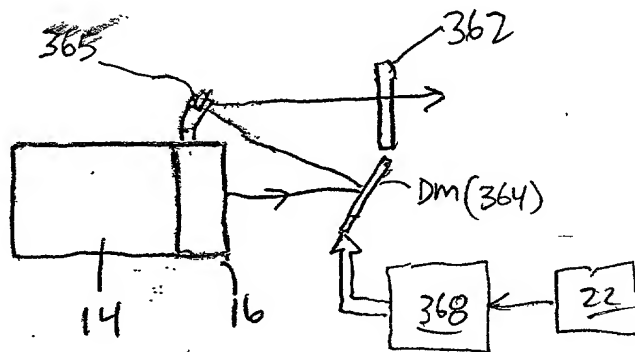


FIG. 1I7C

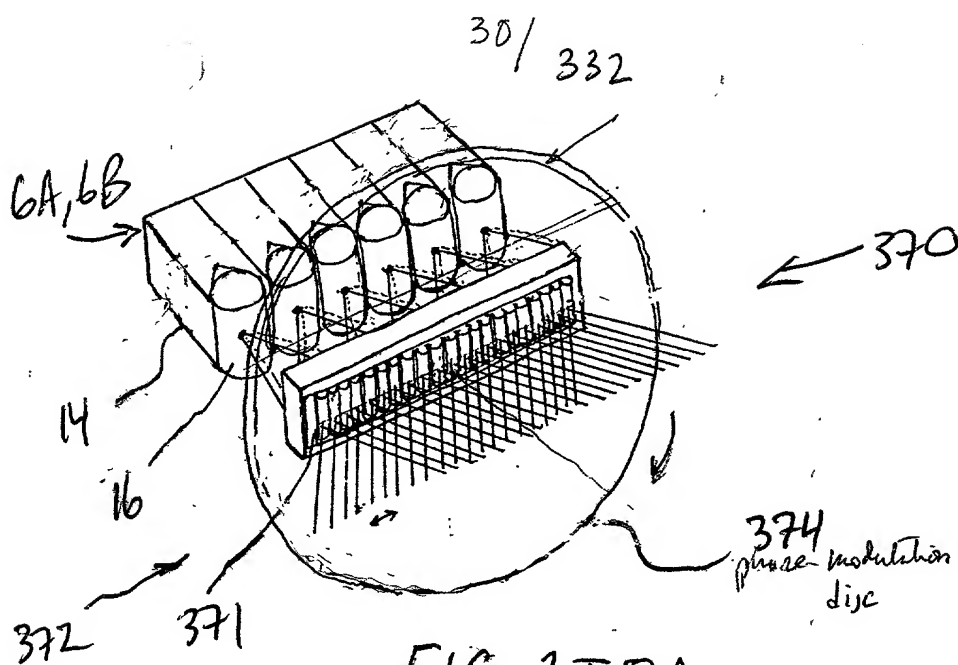


FIG. 1I8A

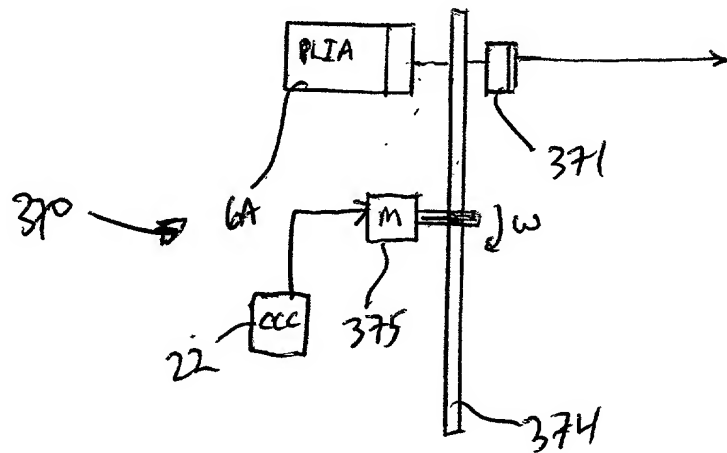


FIG. 1I8B

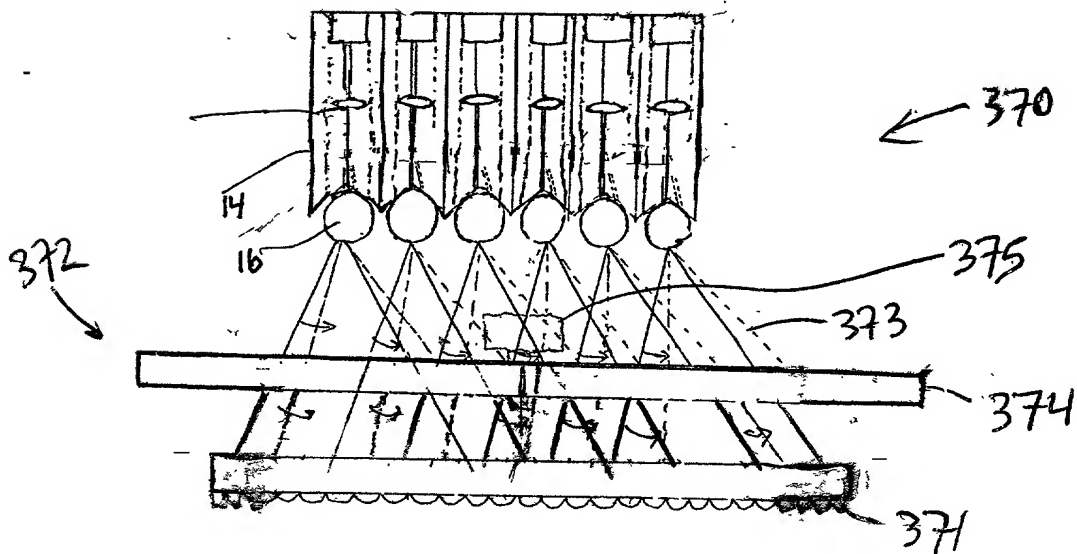


FIG. 1I8C

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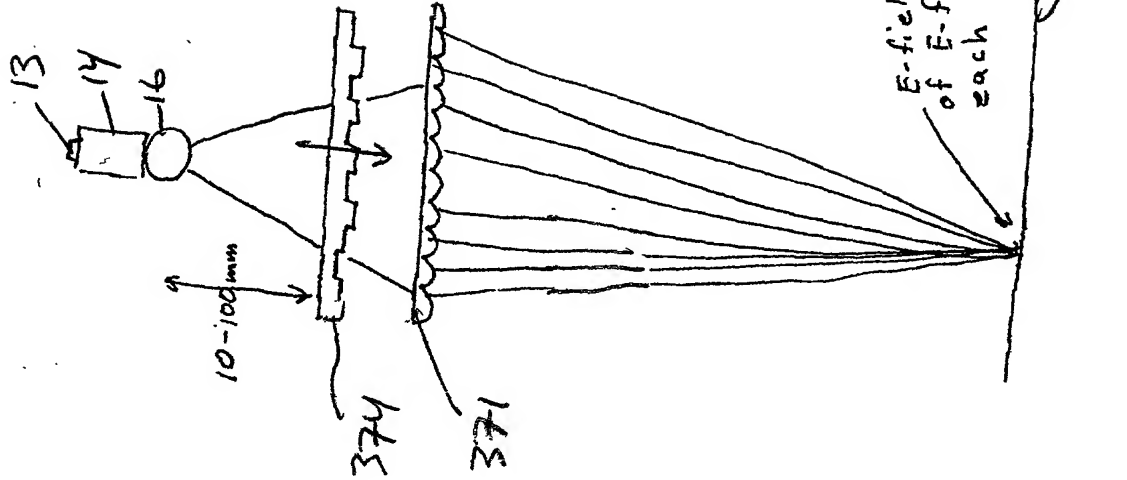


FIG 1I8E

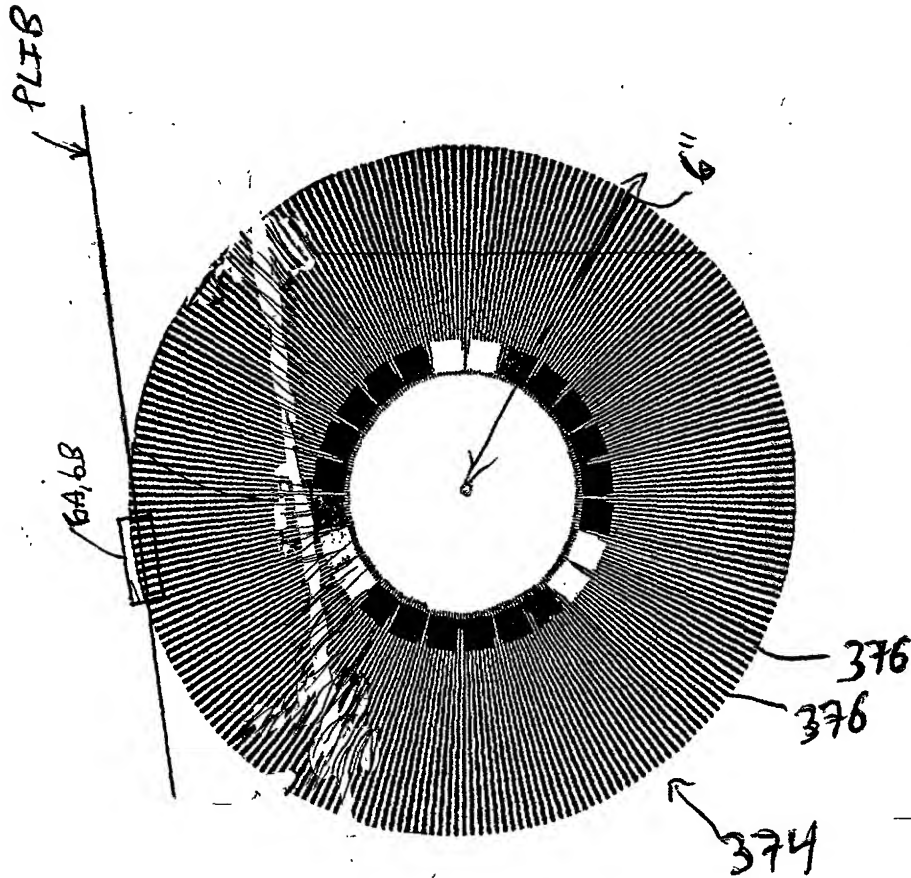
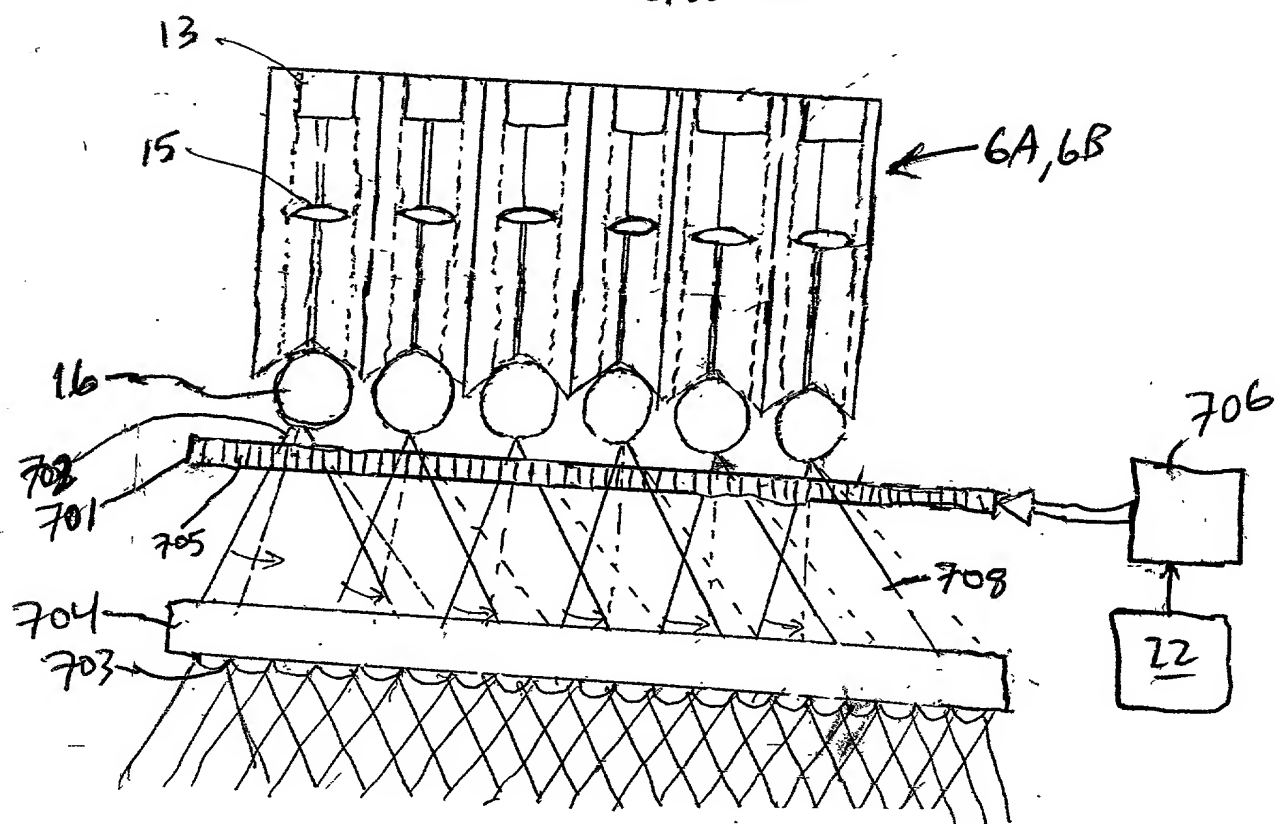
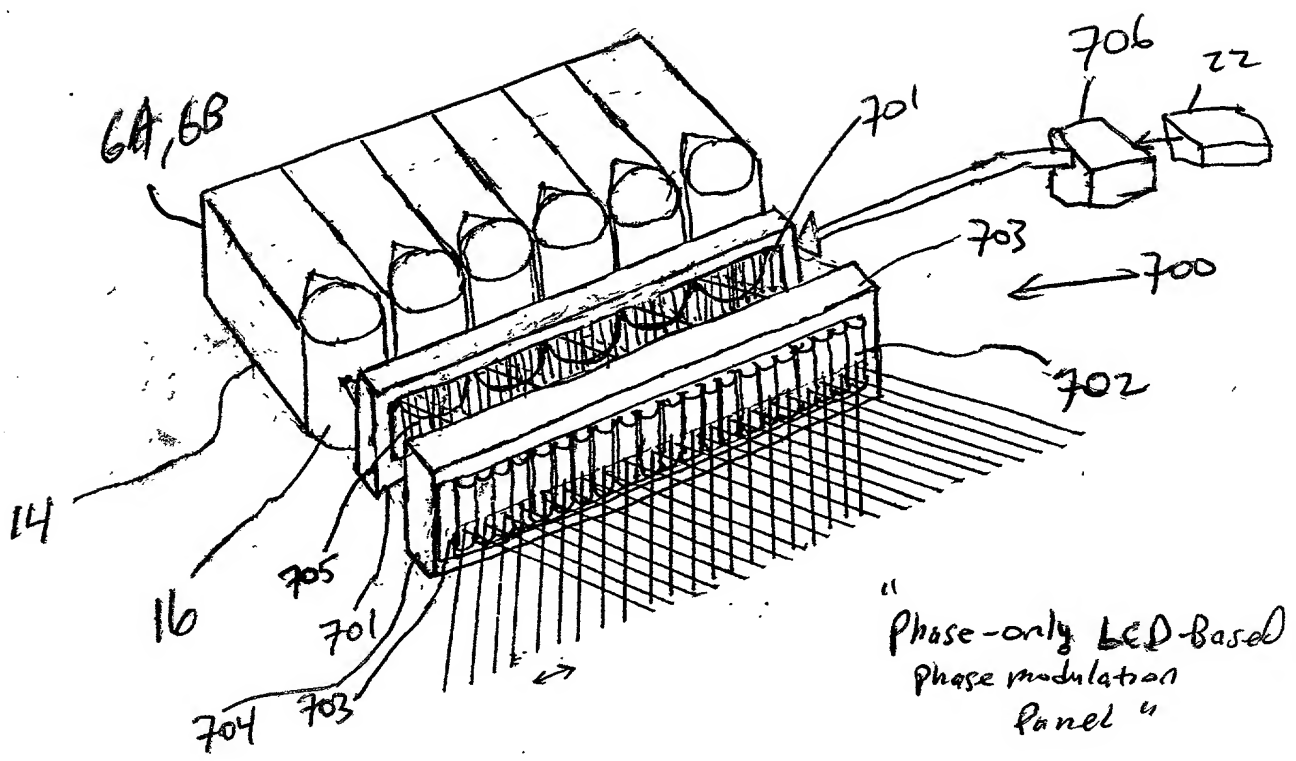


FIG 1I8D



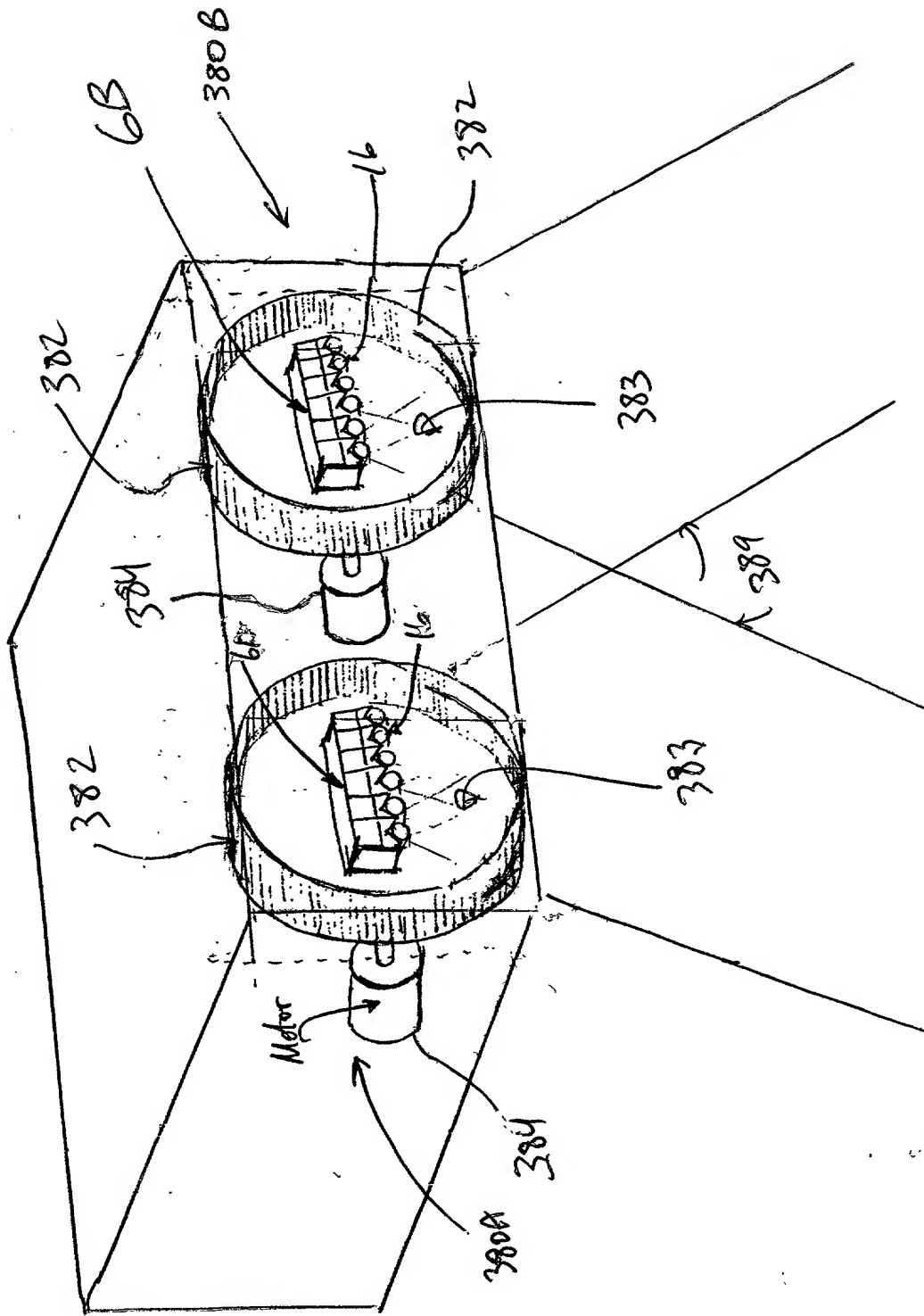


FIG. 1I 9A

Optical specifications:

- 30 cylindrical lens (lines) per linear inch
- focal length = 2.0 millimeters
- diameter of lens holder carousel ≈ 4 inches
- acrylic material

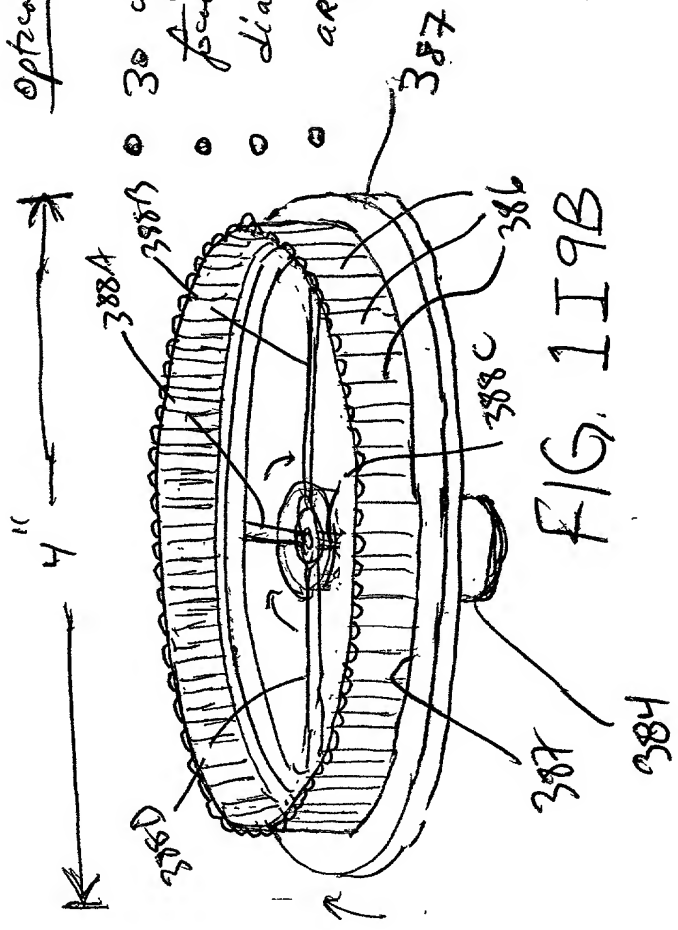


FIG. 1I9B

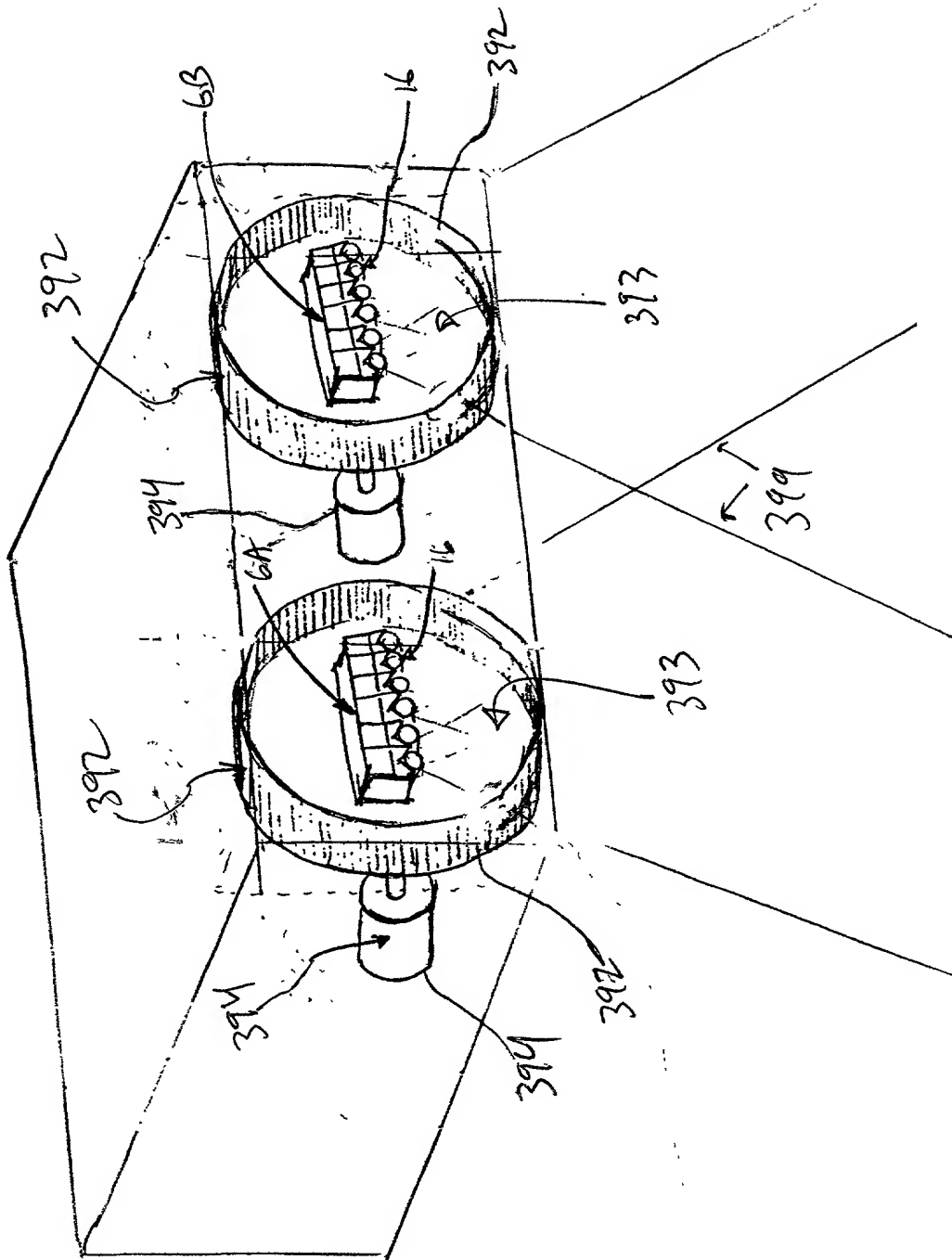


FIG. 1110A

Optical specifications:

- 30 cylindrical lens (lenses) per linear inch
- focal length : 2.0 millimeters
- diameter of cylindrical carousel ≈ 4 inches

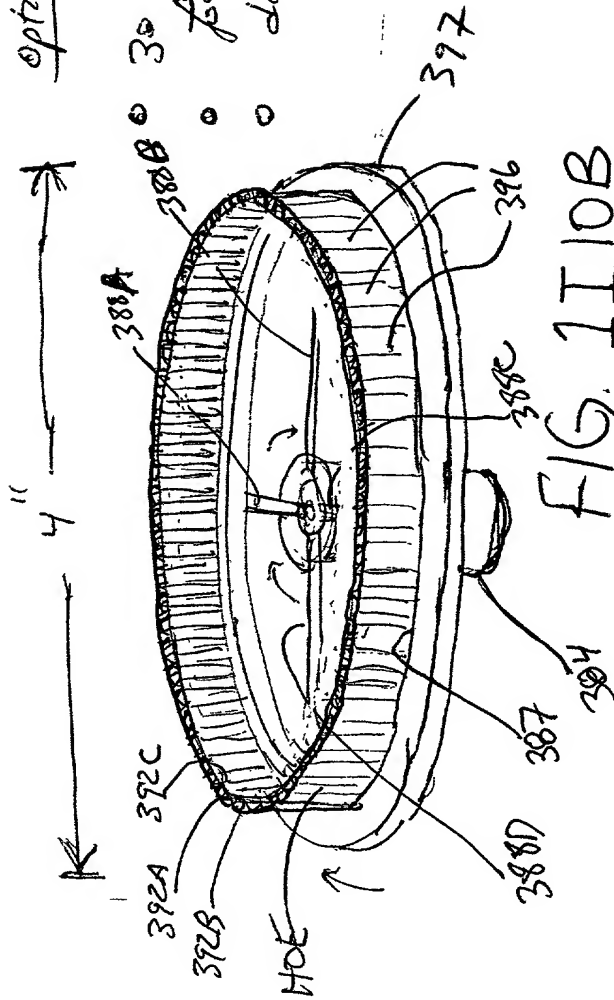
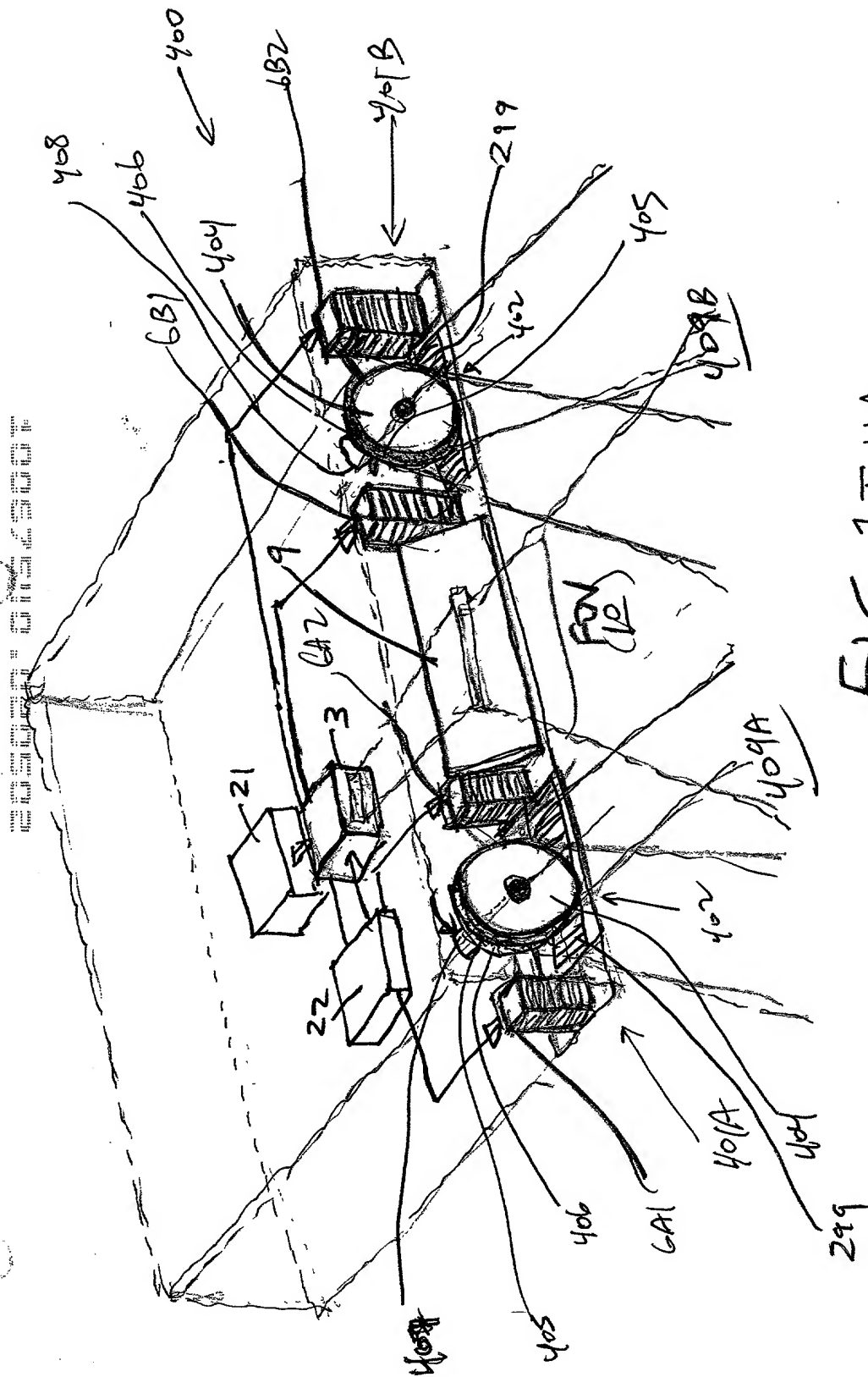


FIG. 1110B



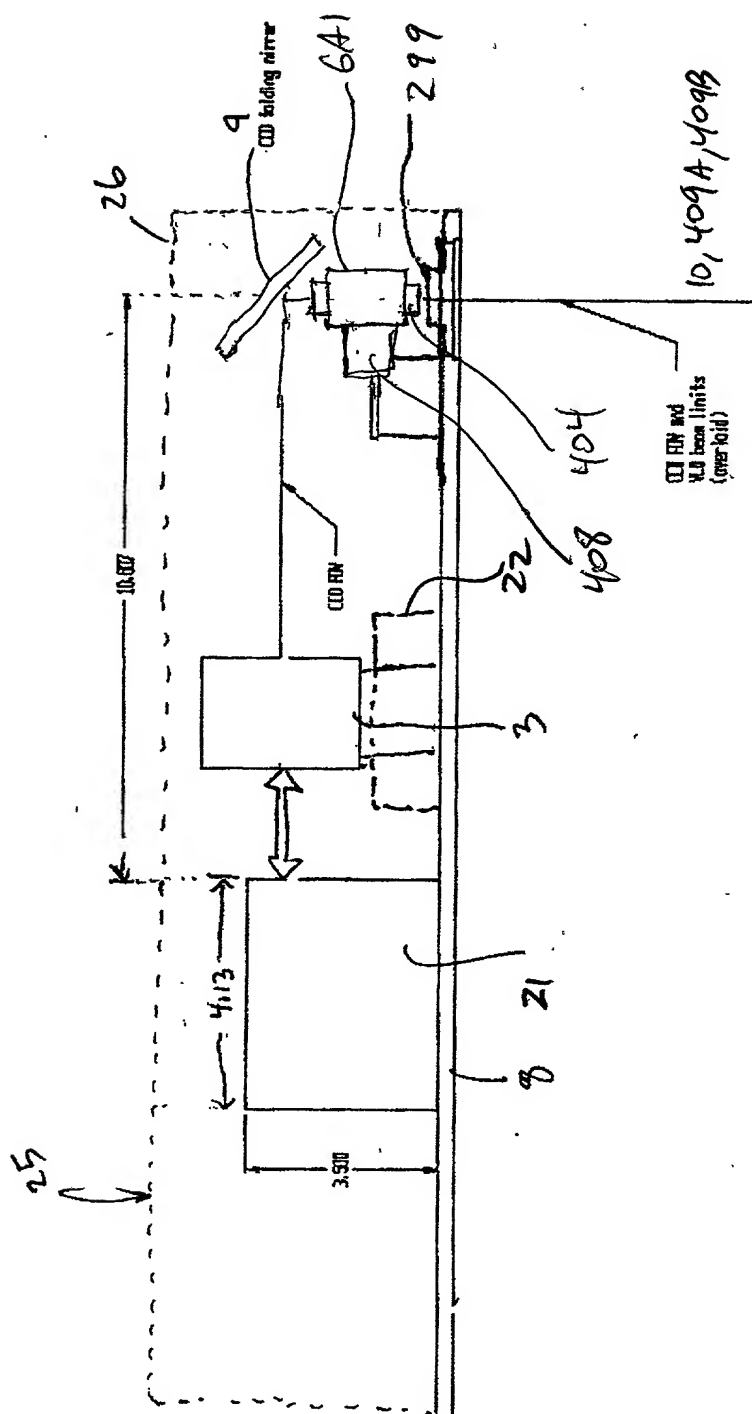


FIG 11B

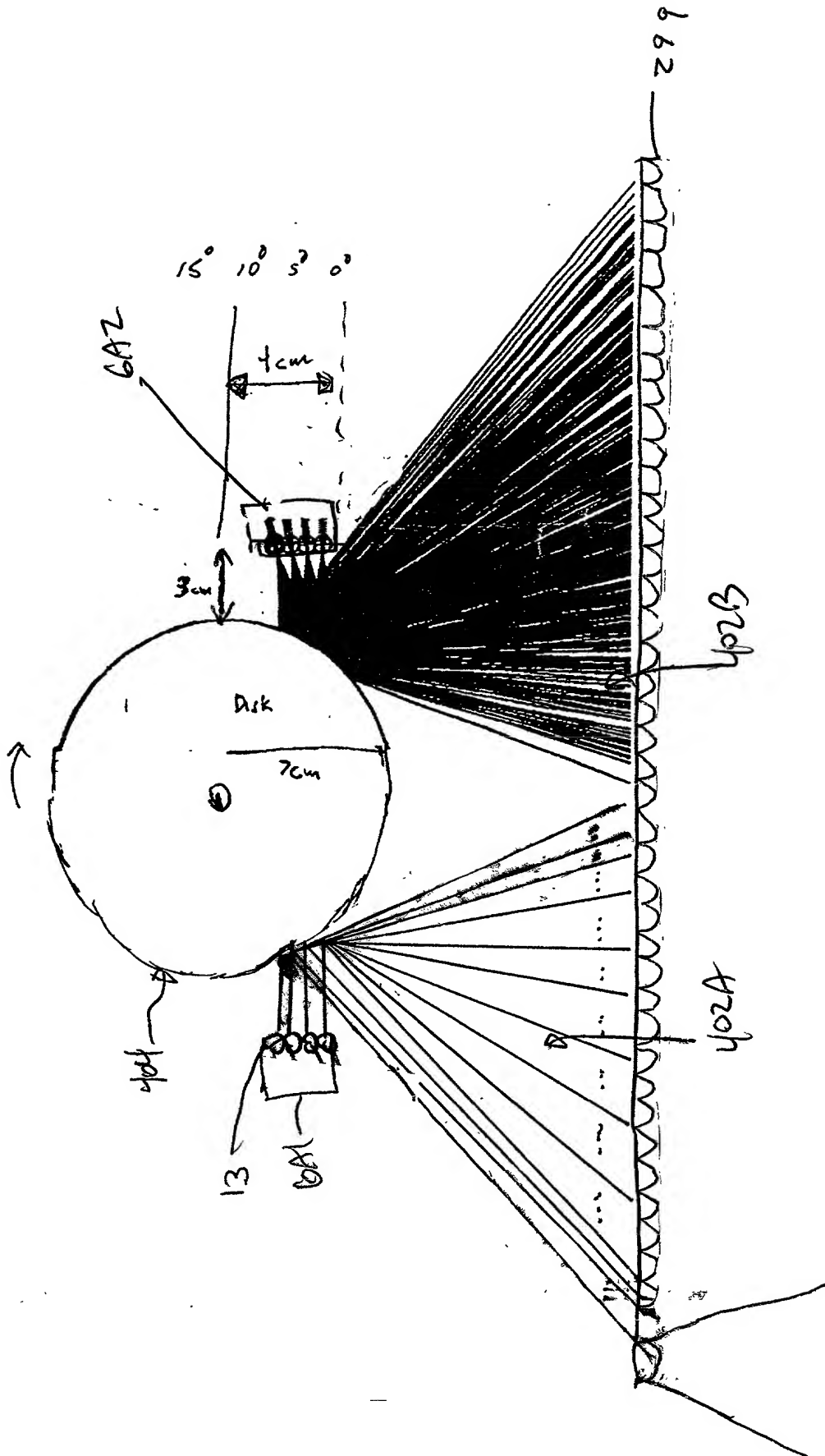


FIG. 1I11C

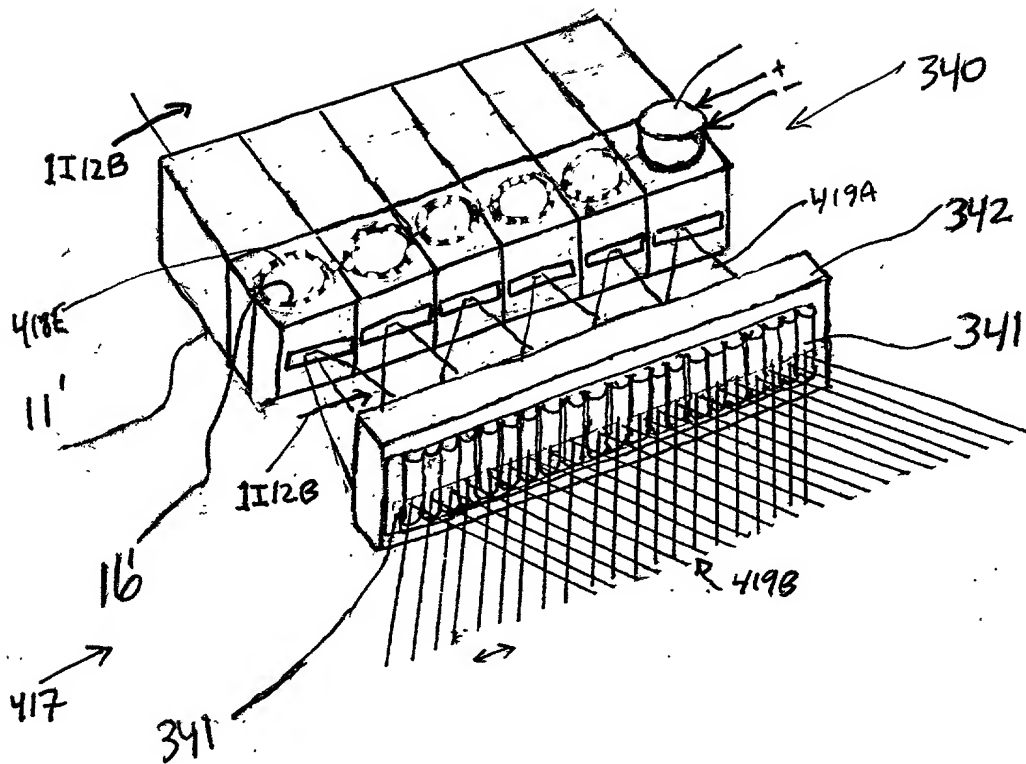


FIG. 1I12A

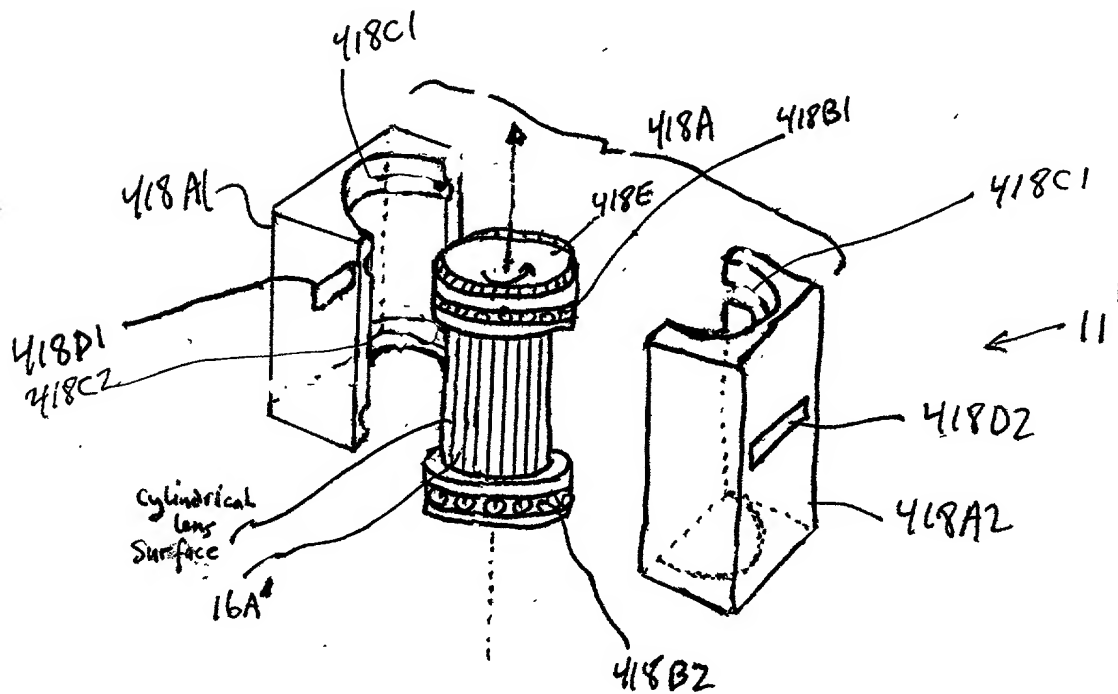


FIG. 1I12B

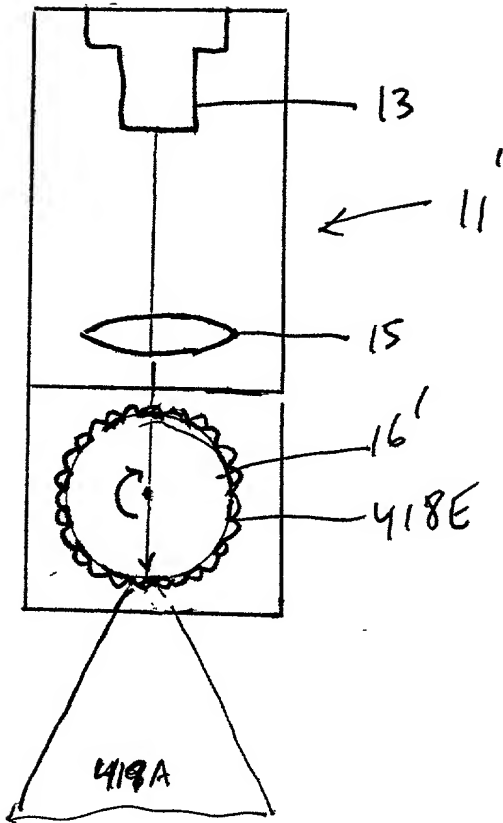


FIG. 1I12C

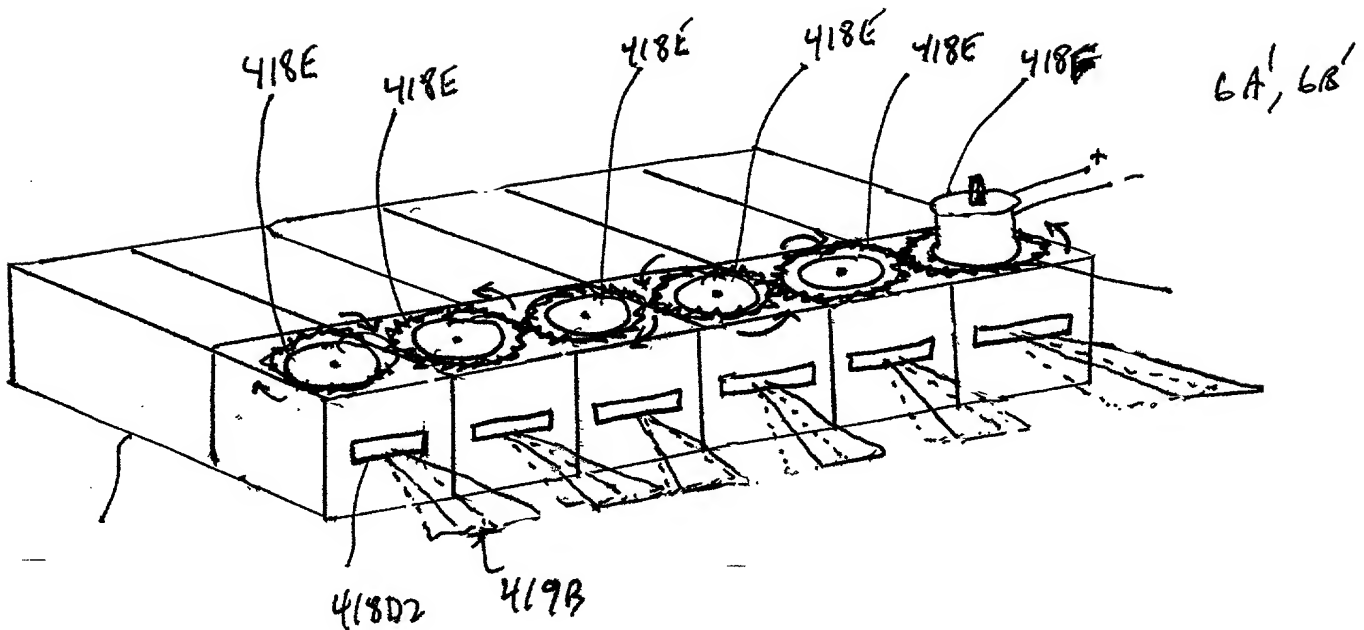


FIG. 1I12D

Second Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

(TIME)

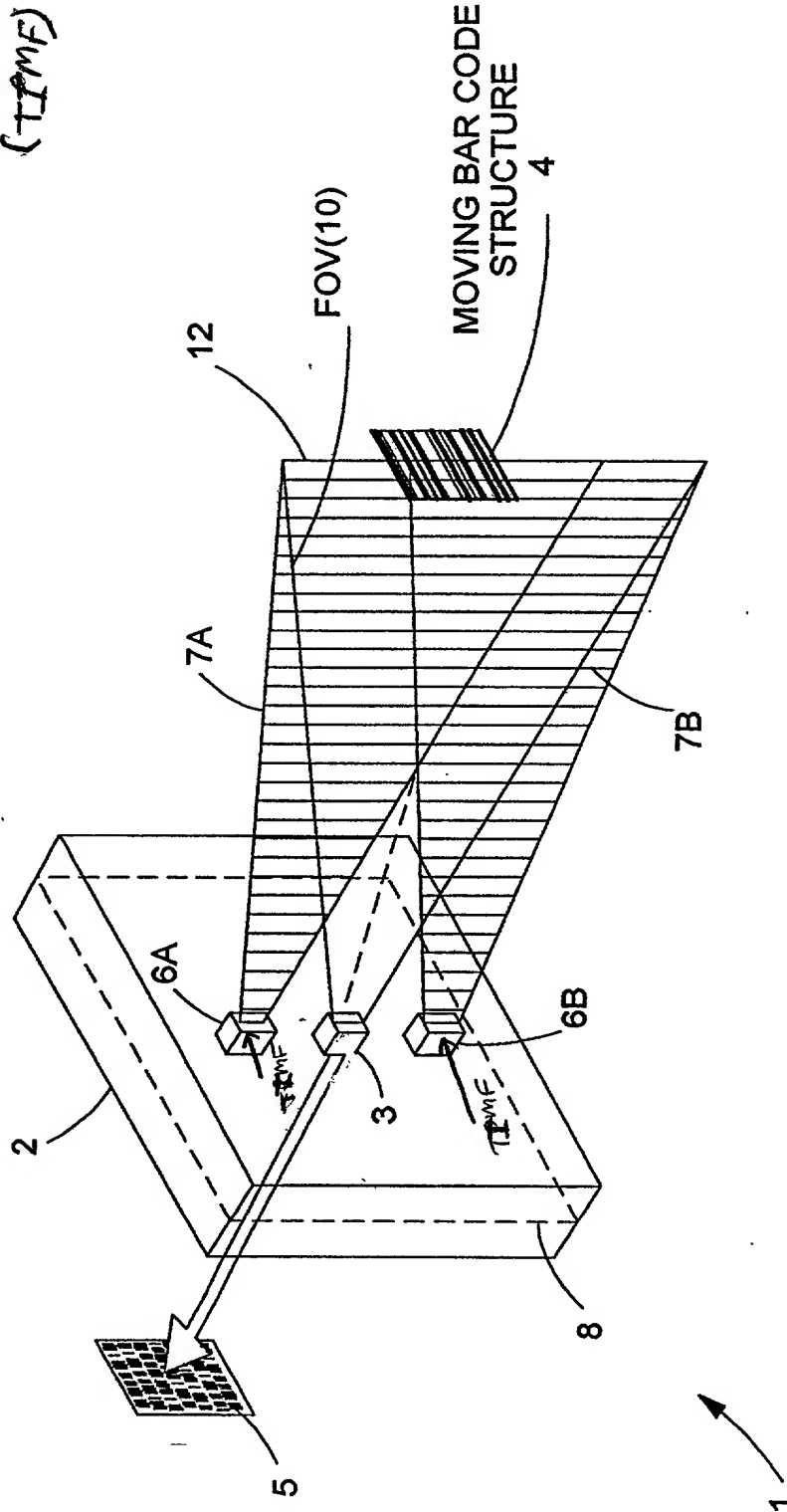


FIG. 1113

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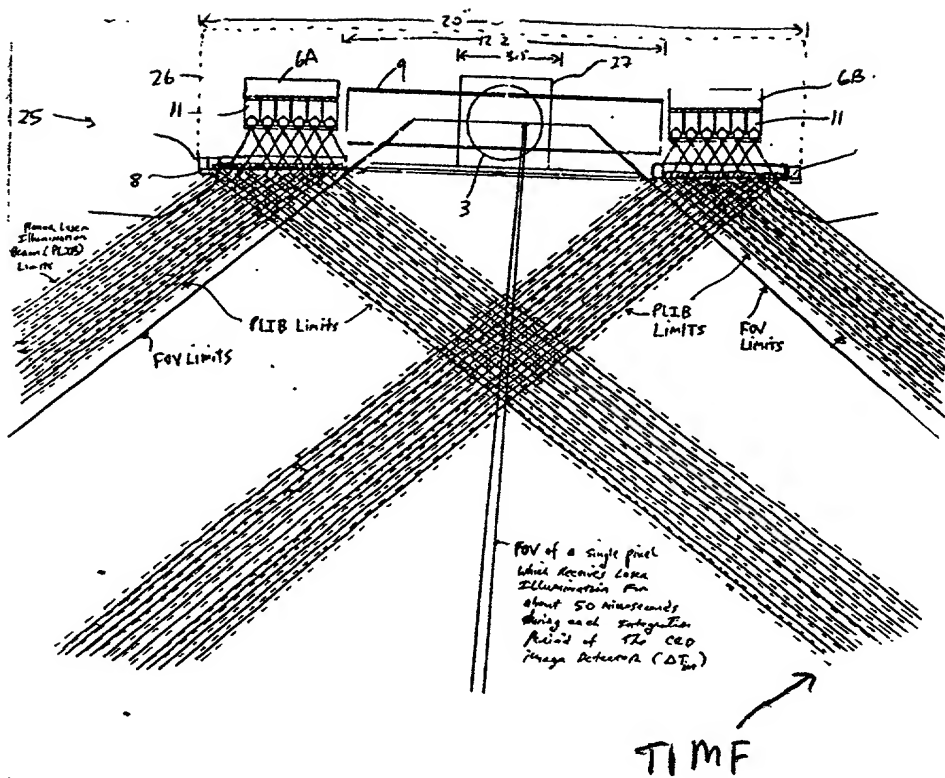


FIG. 1 I 13A

The Second Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the transmitted PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to

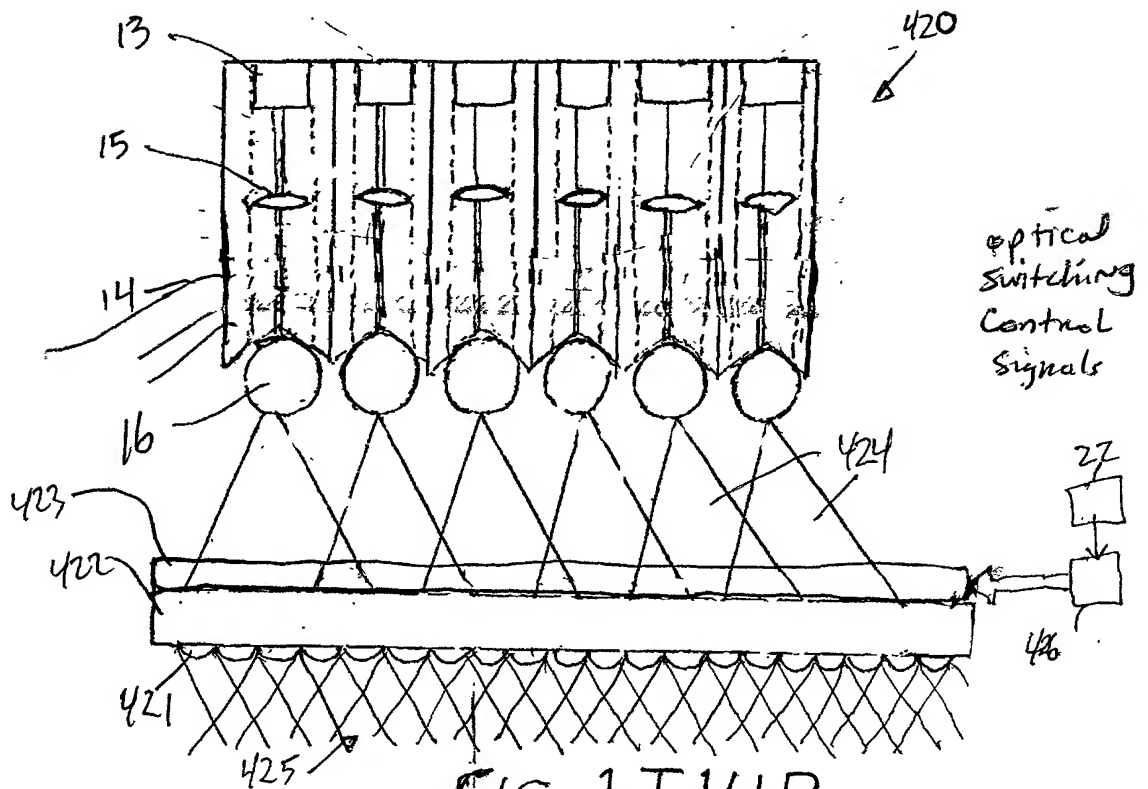
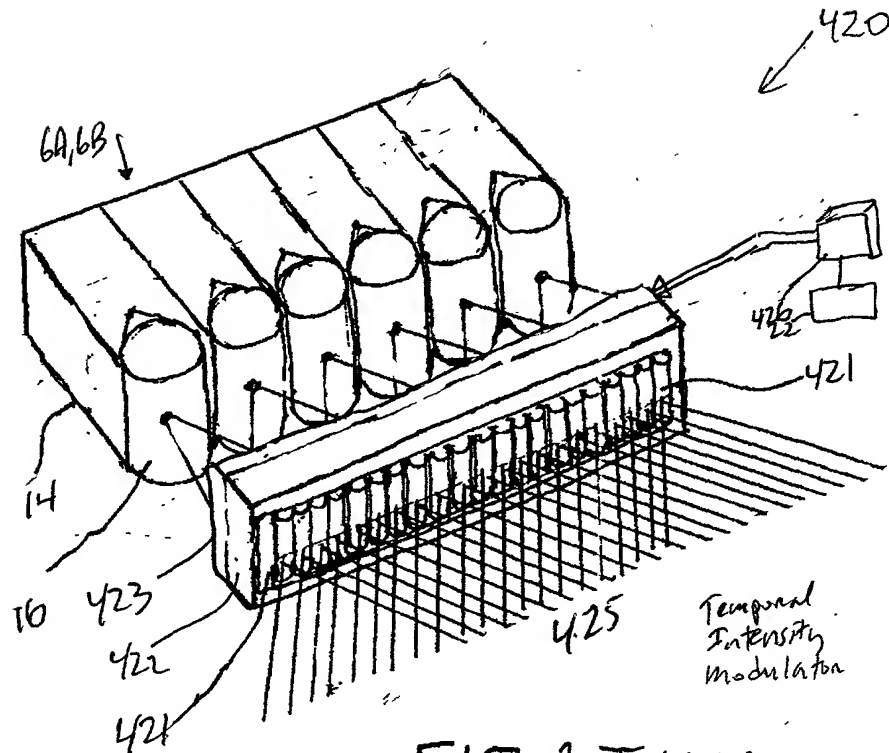
produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

A

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

B

FIG. 1I/3B



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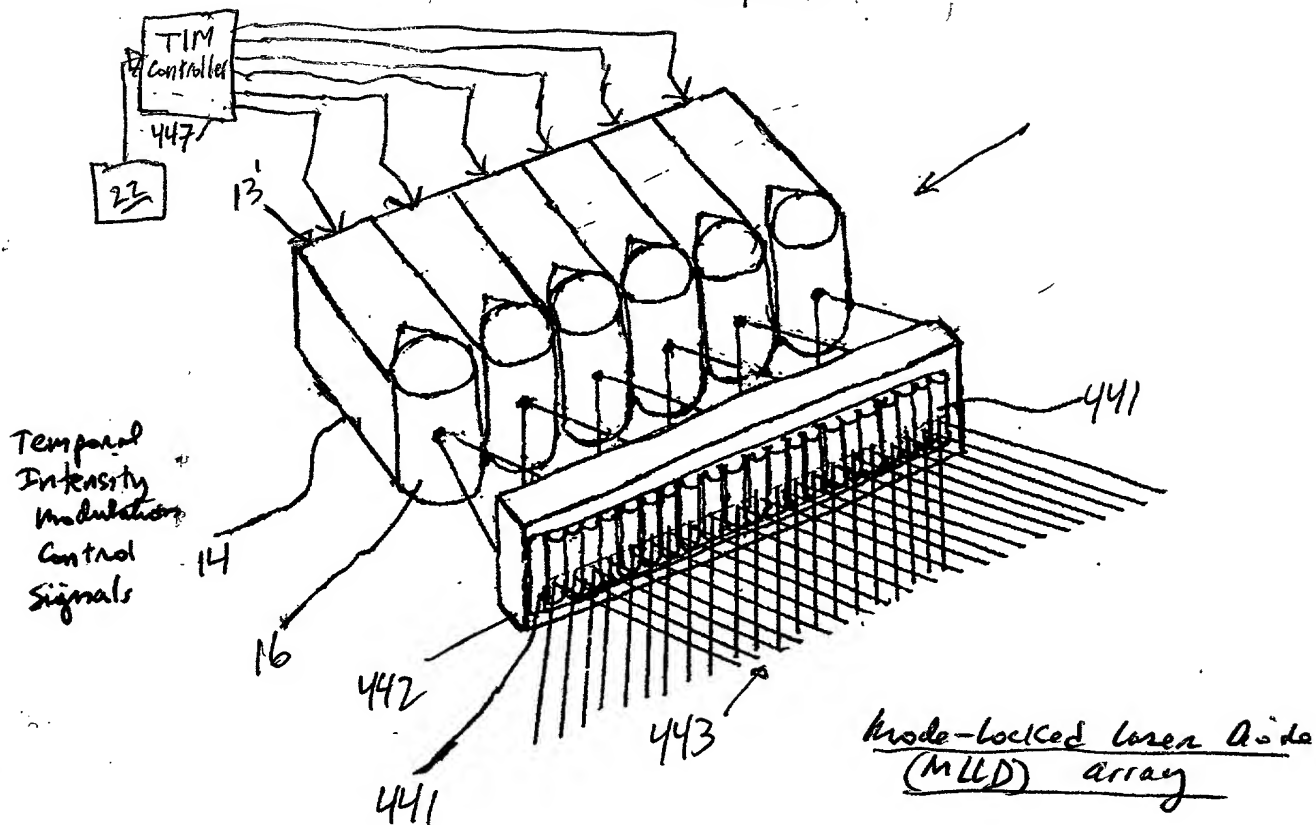


FIG. 1I15A

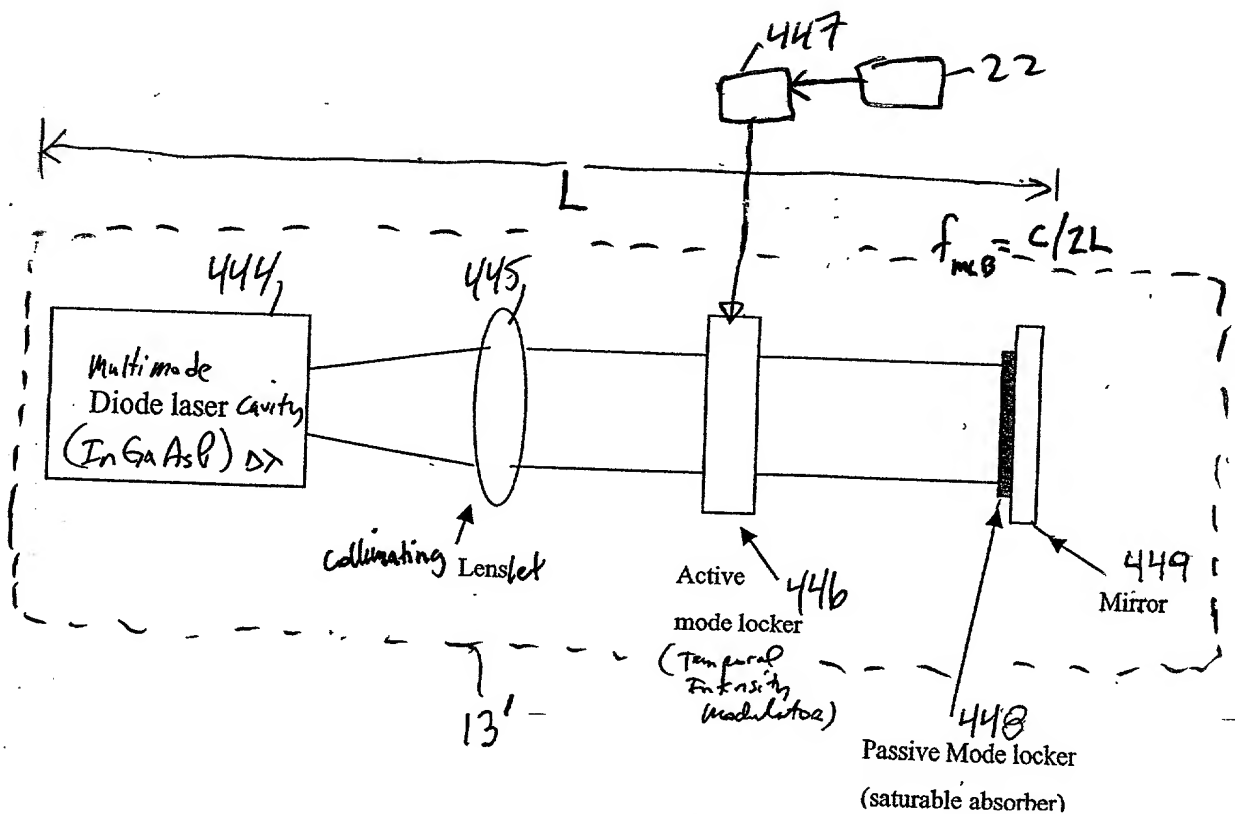
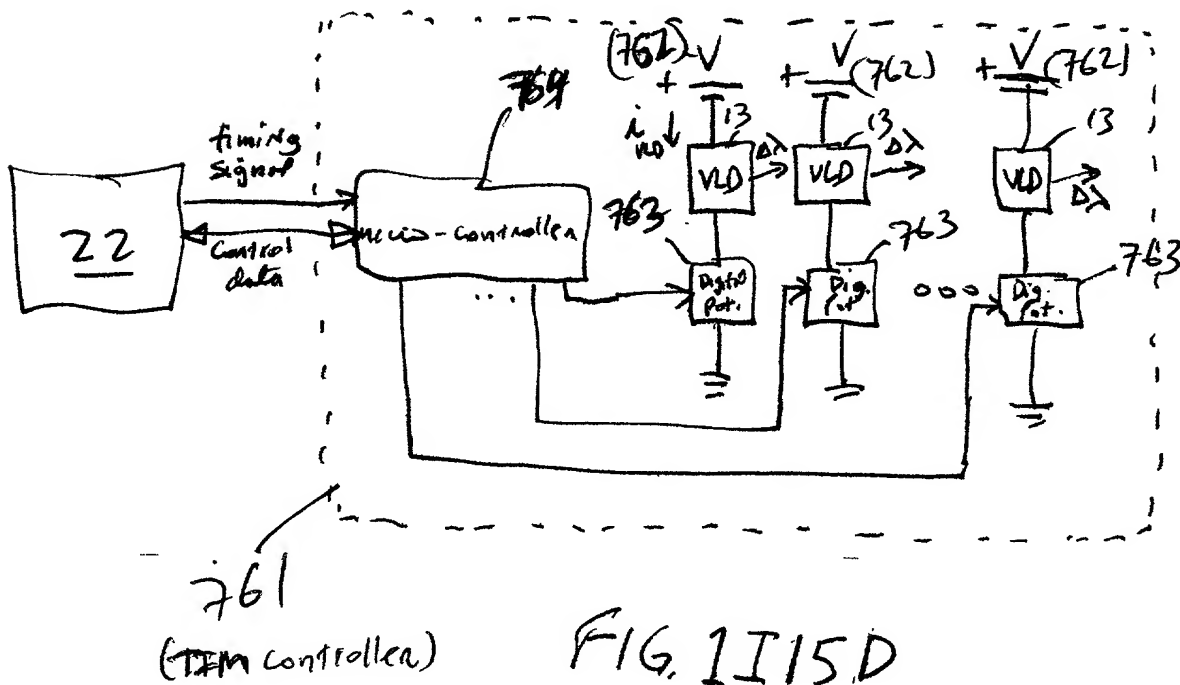
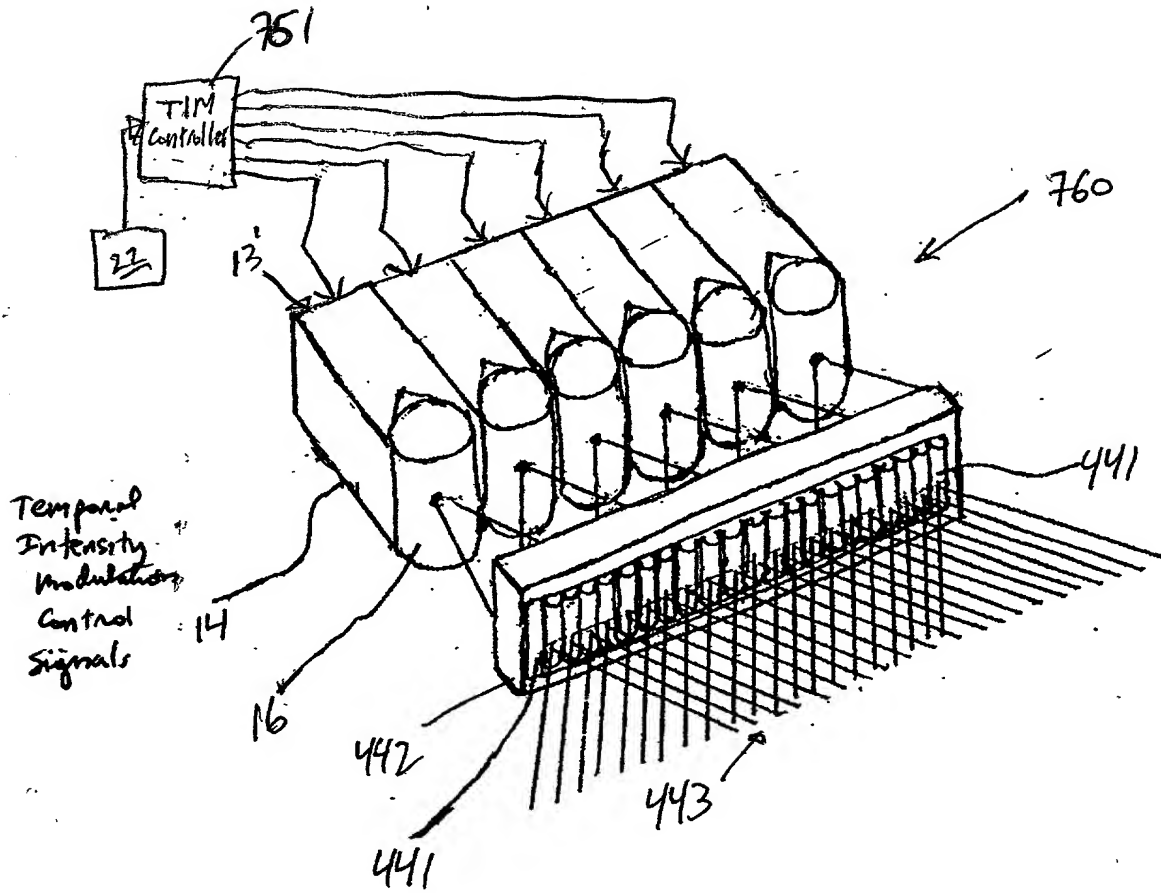


FIG. 1I15B



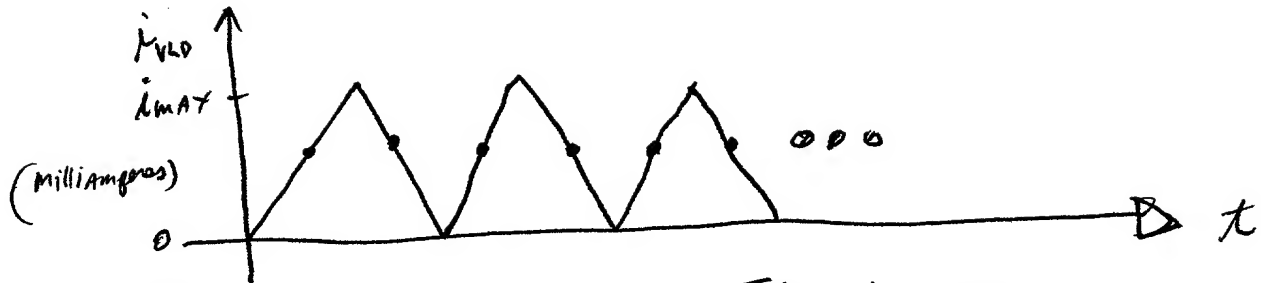


FIG. 1I15E

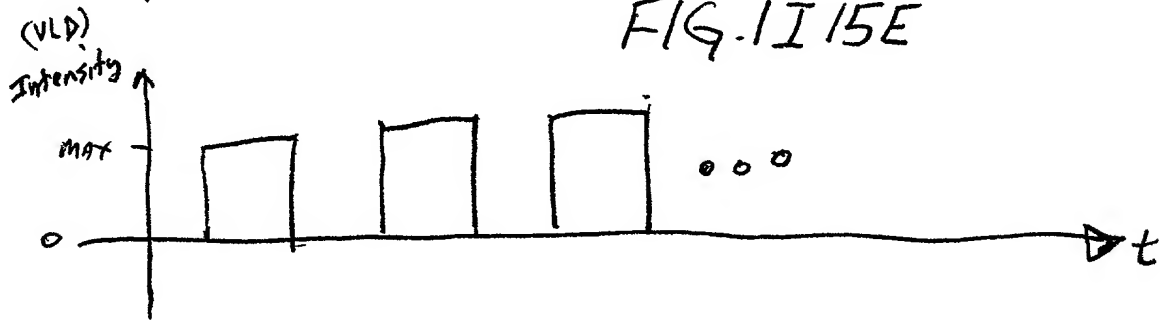


FIG. 1I15E

Third Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

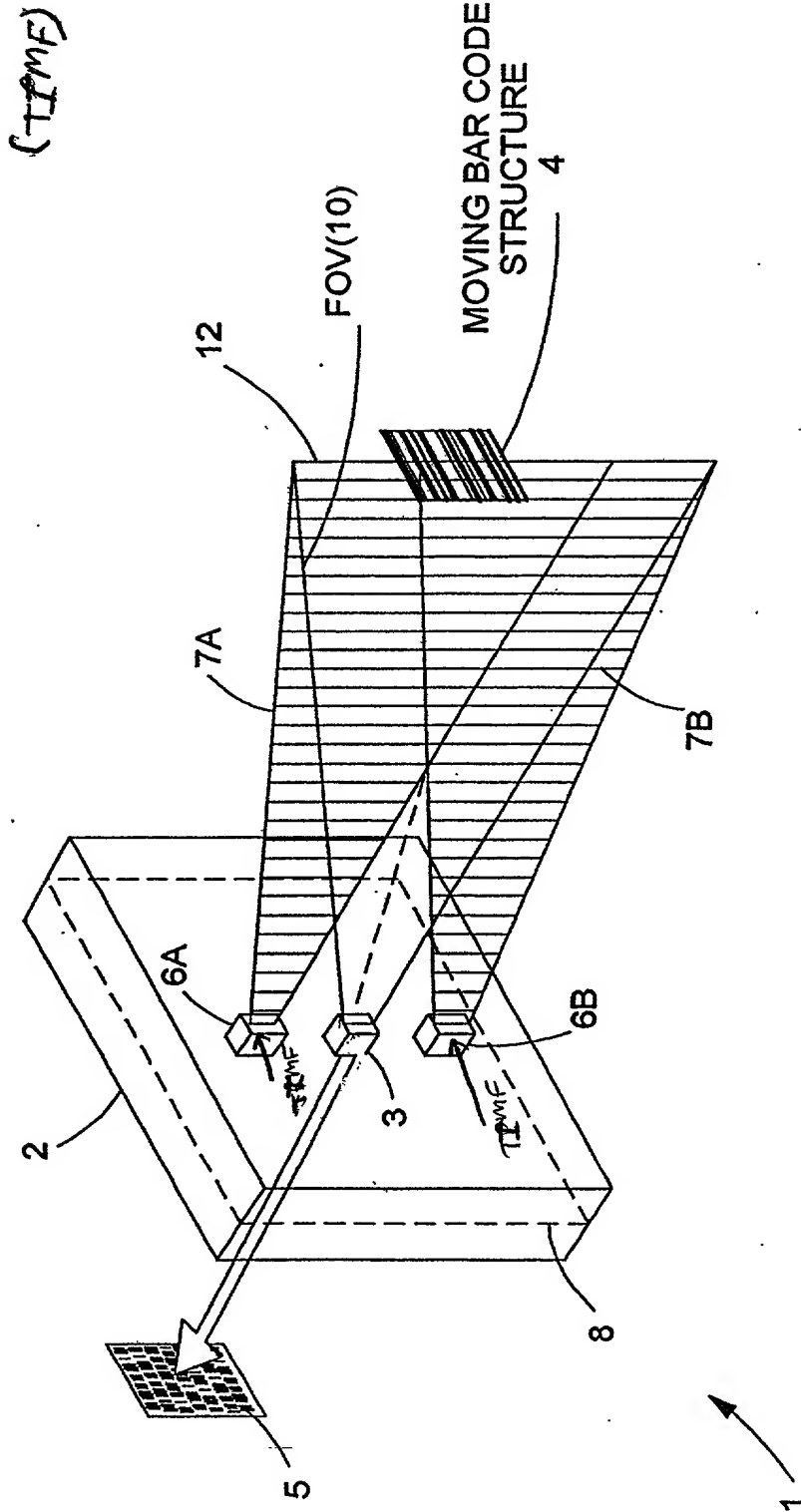


FIG. 1116

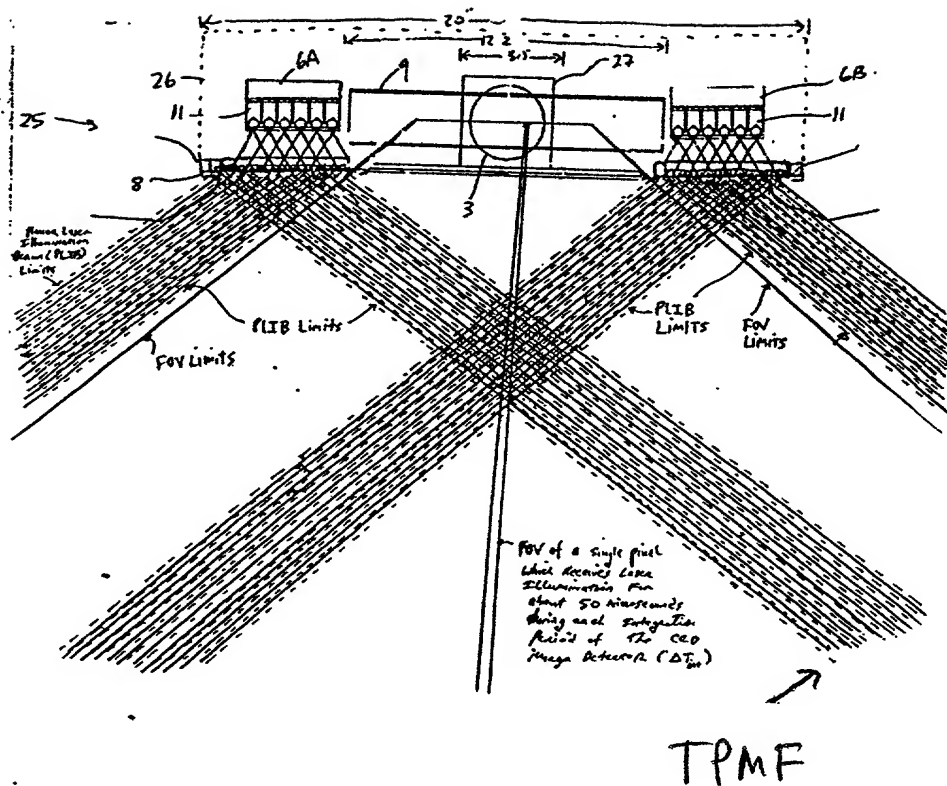


FIG. 11 16A

Third Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal *phase* of the transmitted PLIB ~~along the planar extent thereof~~ according to a *Temporal phase* modulation function (TPMF) so as to:

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.



Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG. 1I/6B

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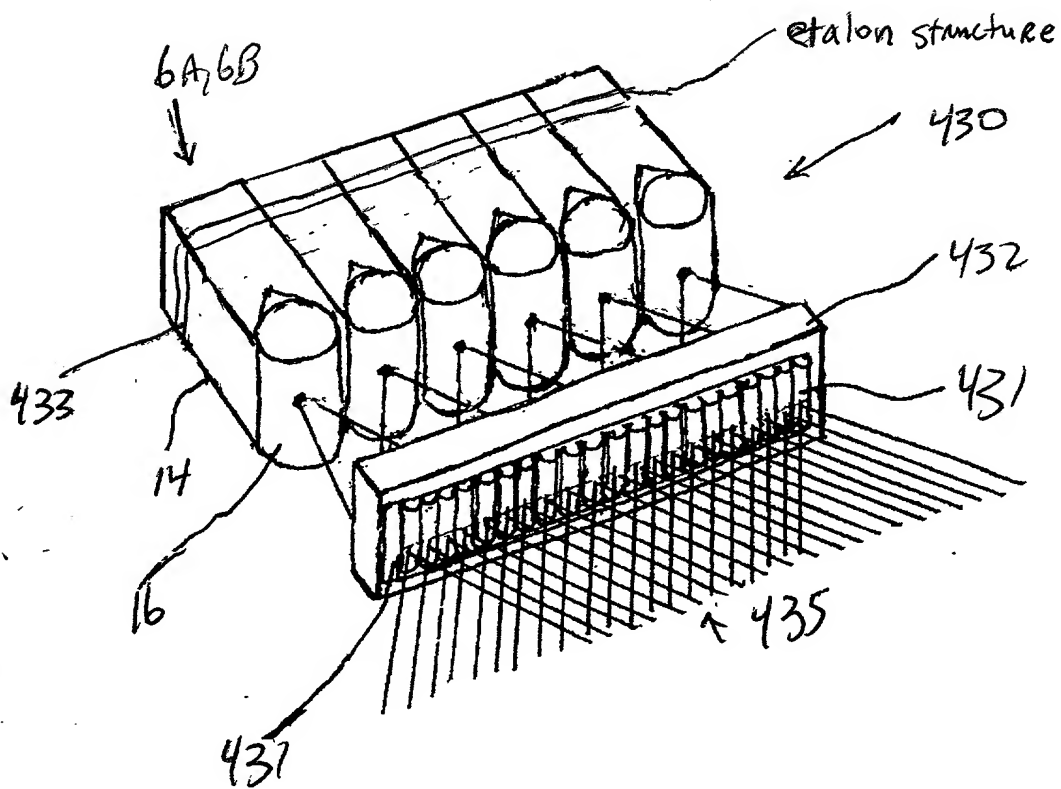


FIG. 1I17A

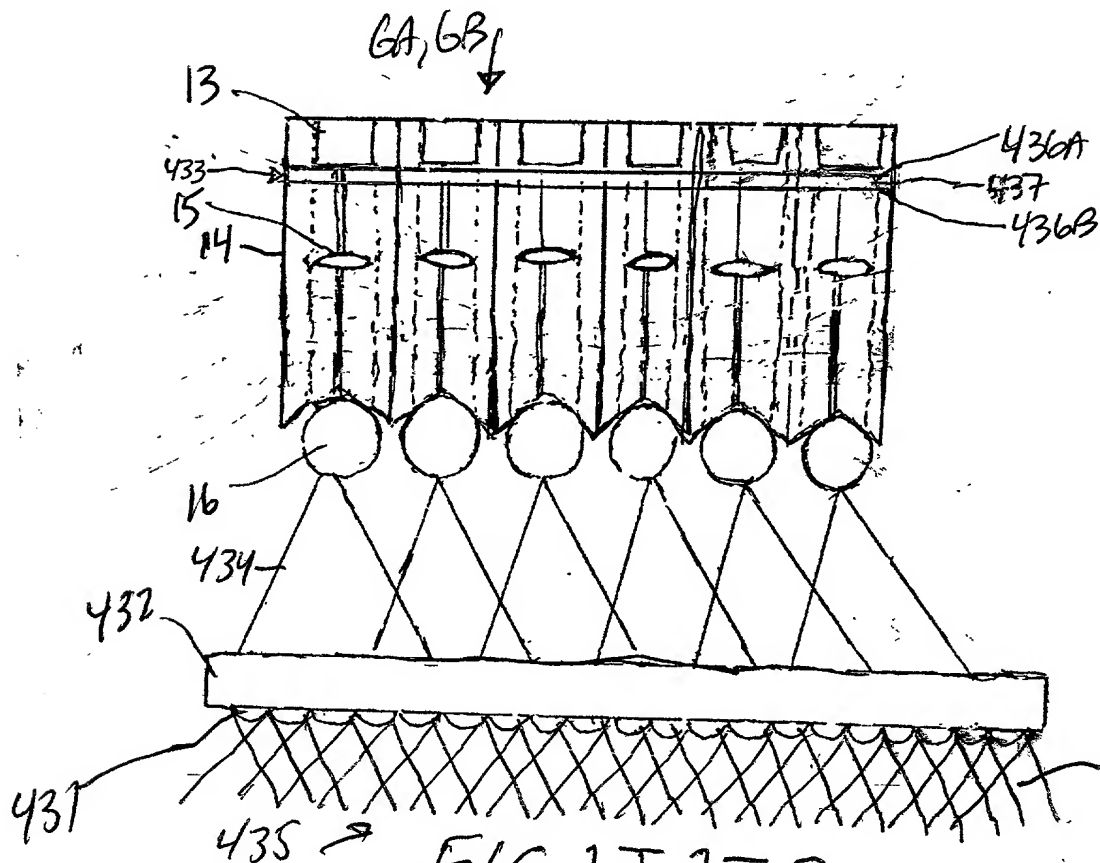
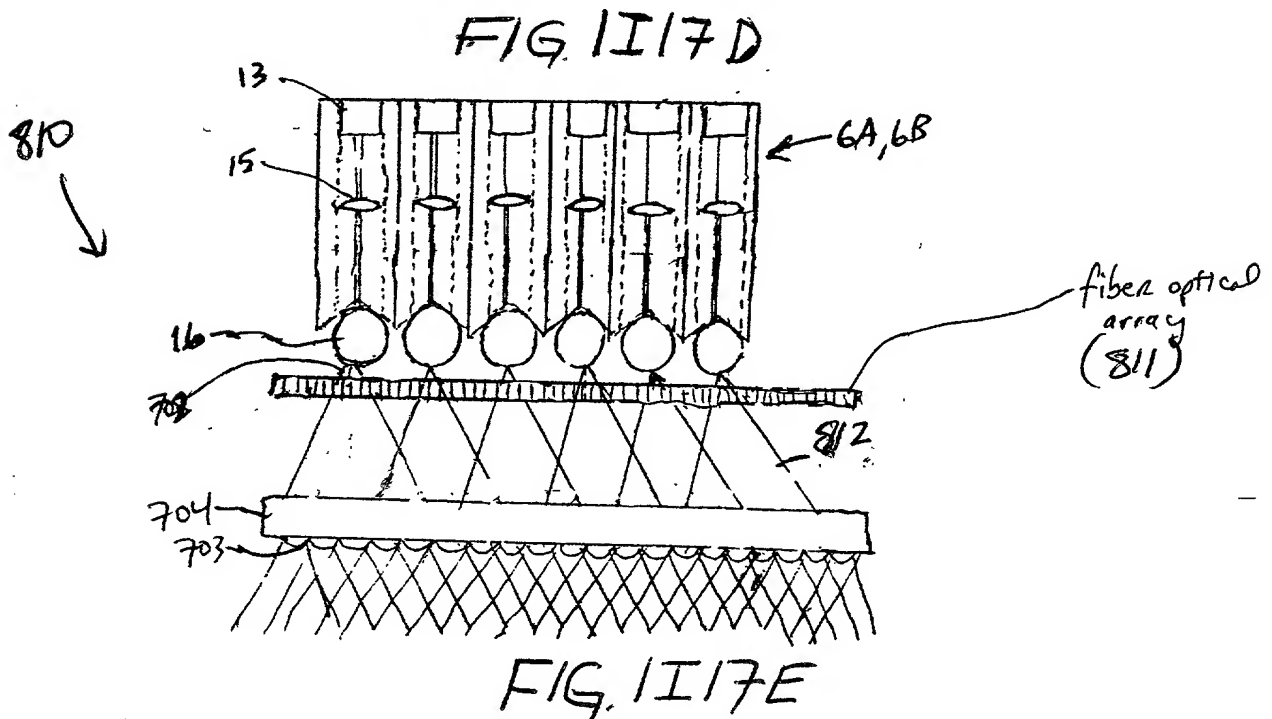
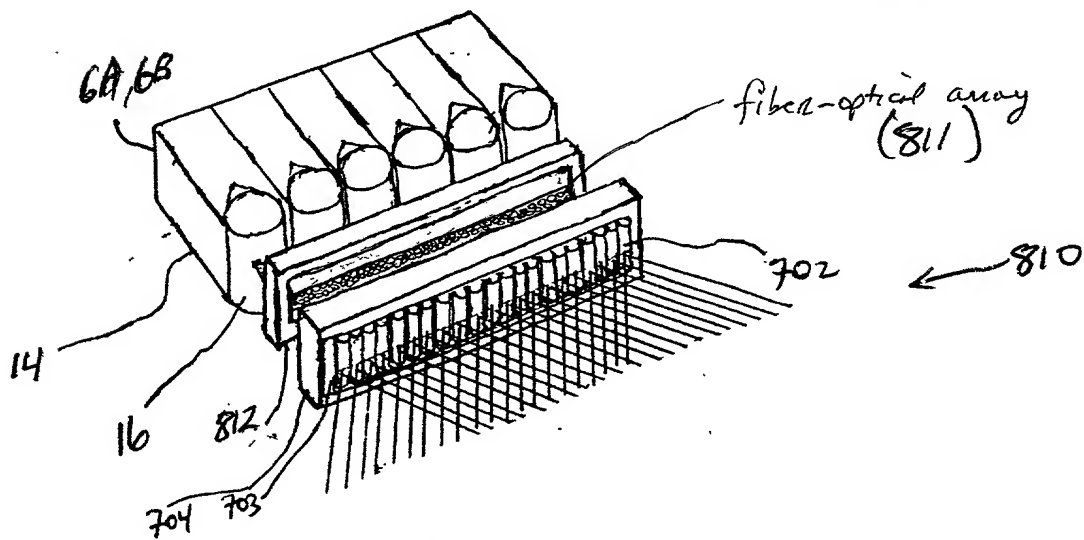
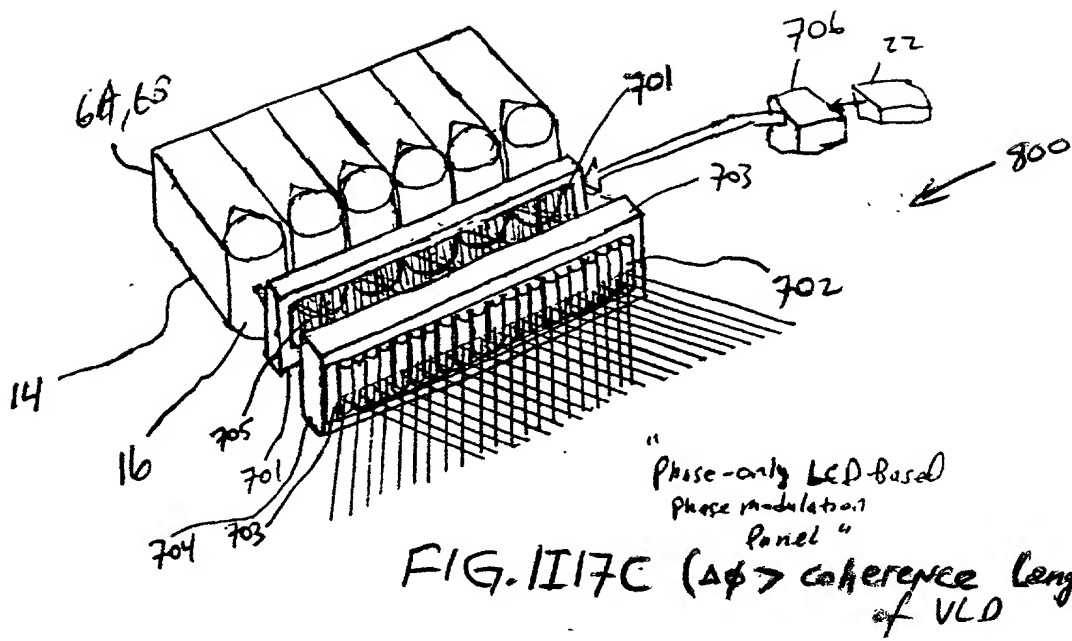


FIG. 1I17B



Fourth Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

(TFMF)

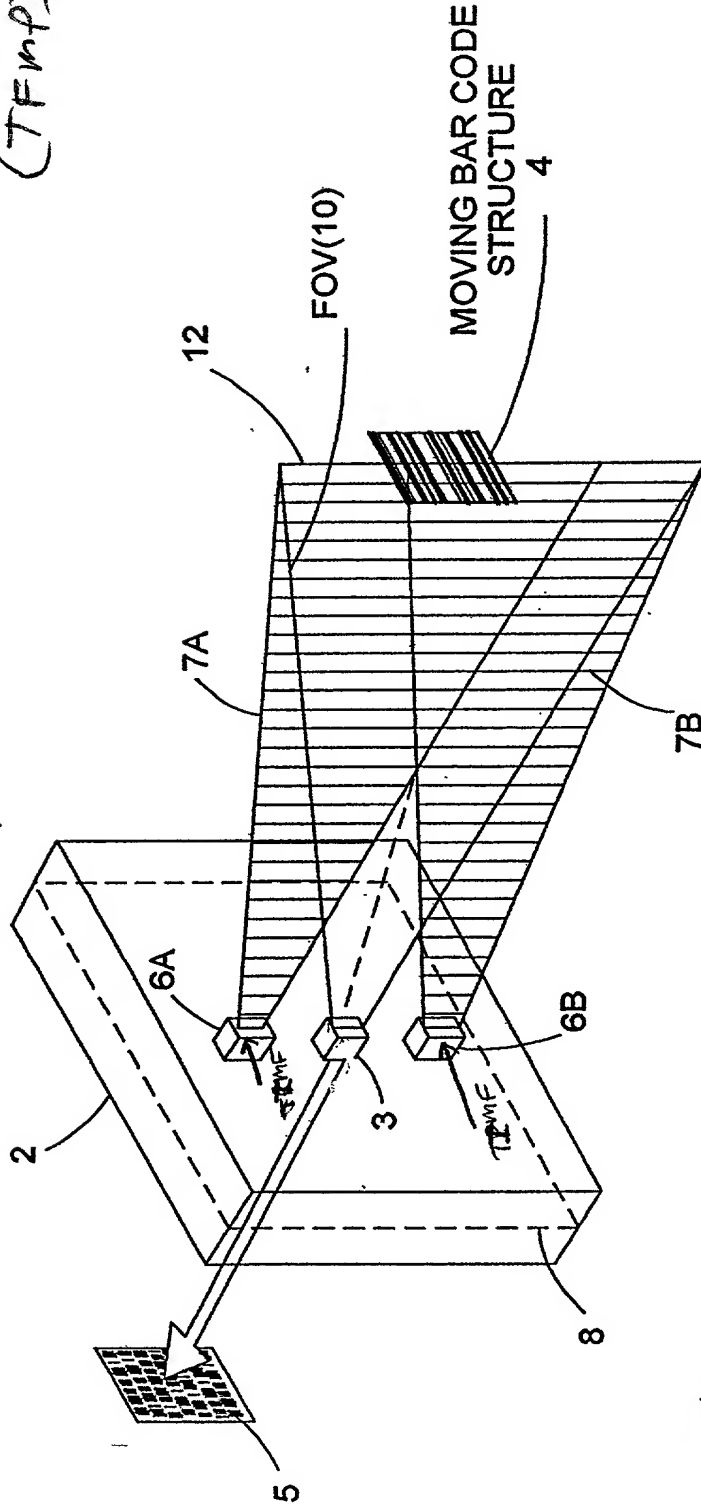


FIG. 1118A

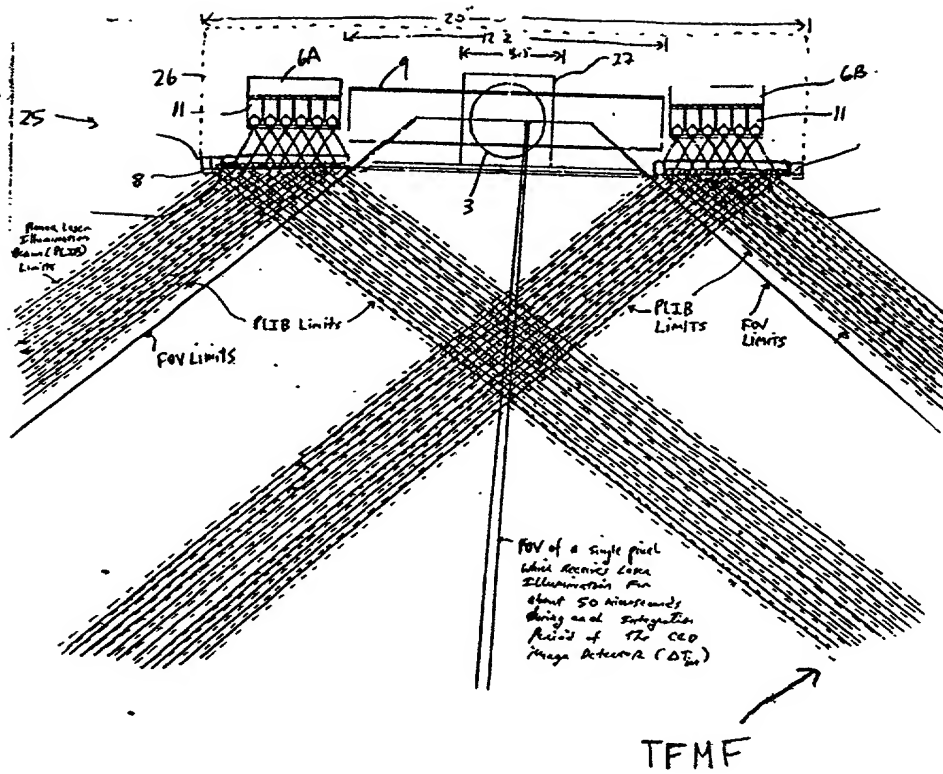


FIG. 1 I 18A

Fourth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal frequency of the transmitted PLIB according to a temporal intensity modulation function (T IMF) so as to ;

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

A

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

B

FIG. 1 I 18 B

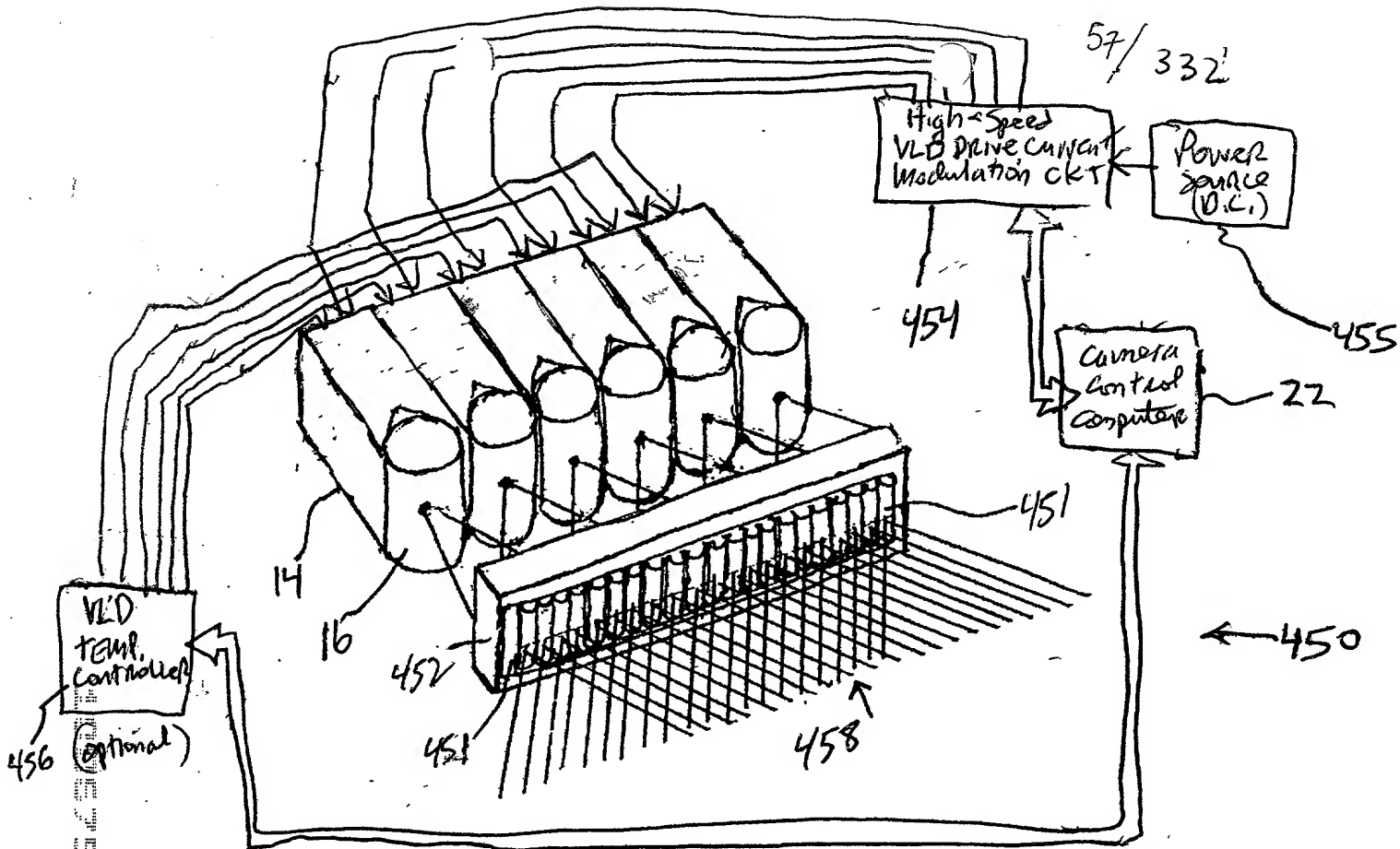
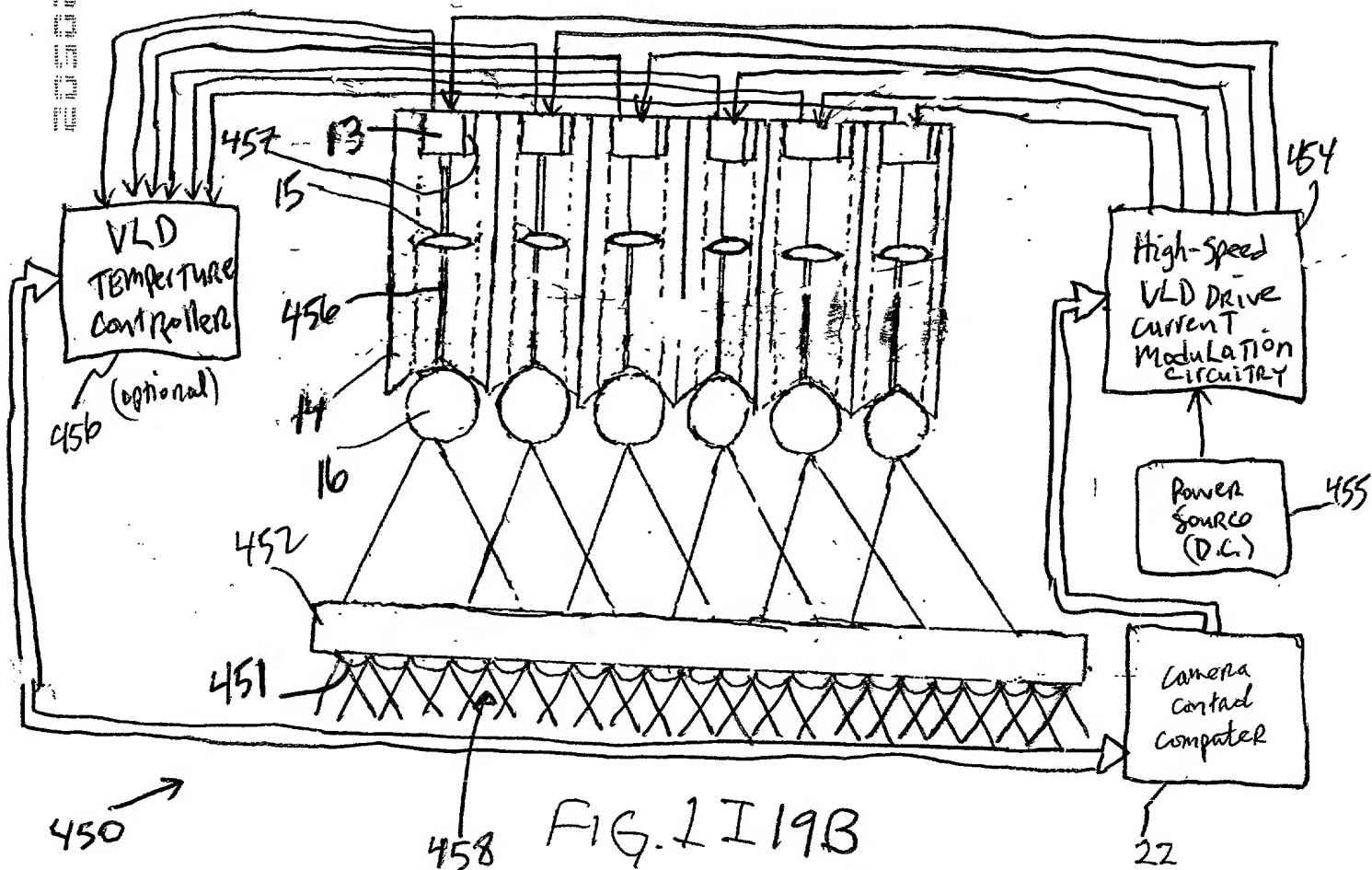


FIG. 1I 19A



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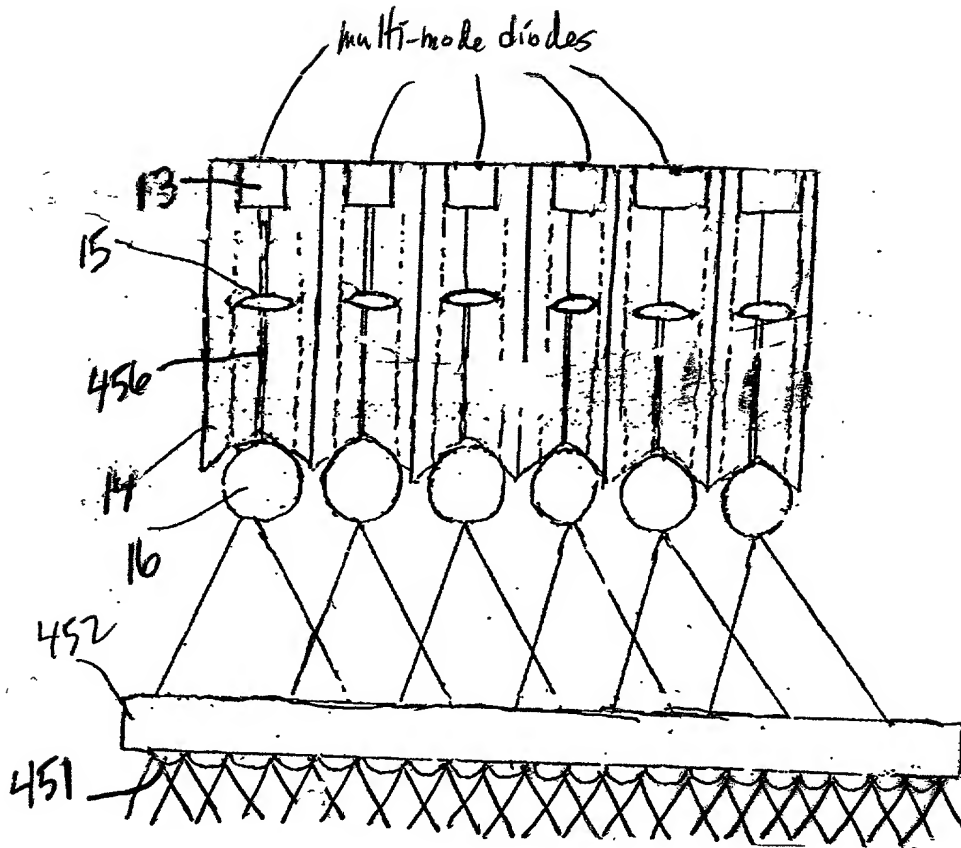


FIG 1I19C

Fifth GENERALIZED METHOD
of Reducing Speckle-Noise
PATTERNS AT IMAGE
DETECTION array OF THE
IFD subsystem (3)

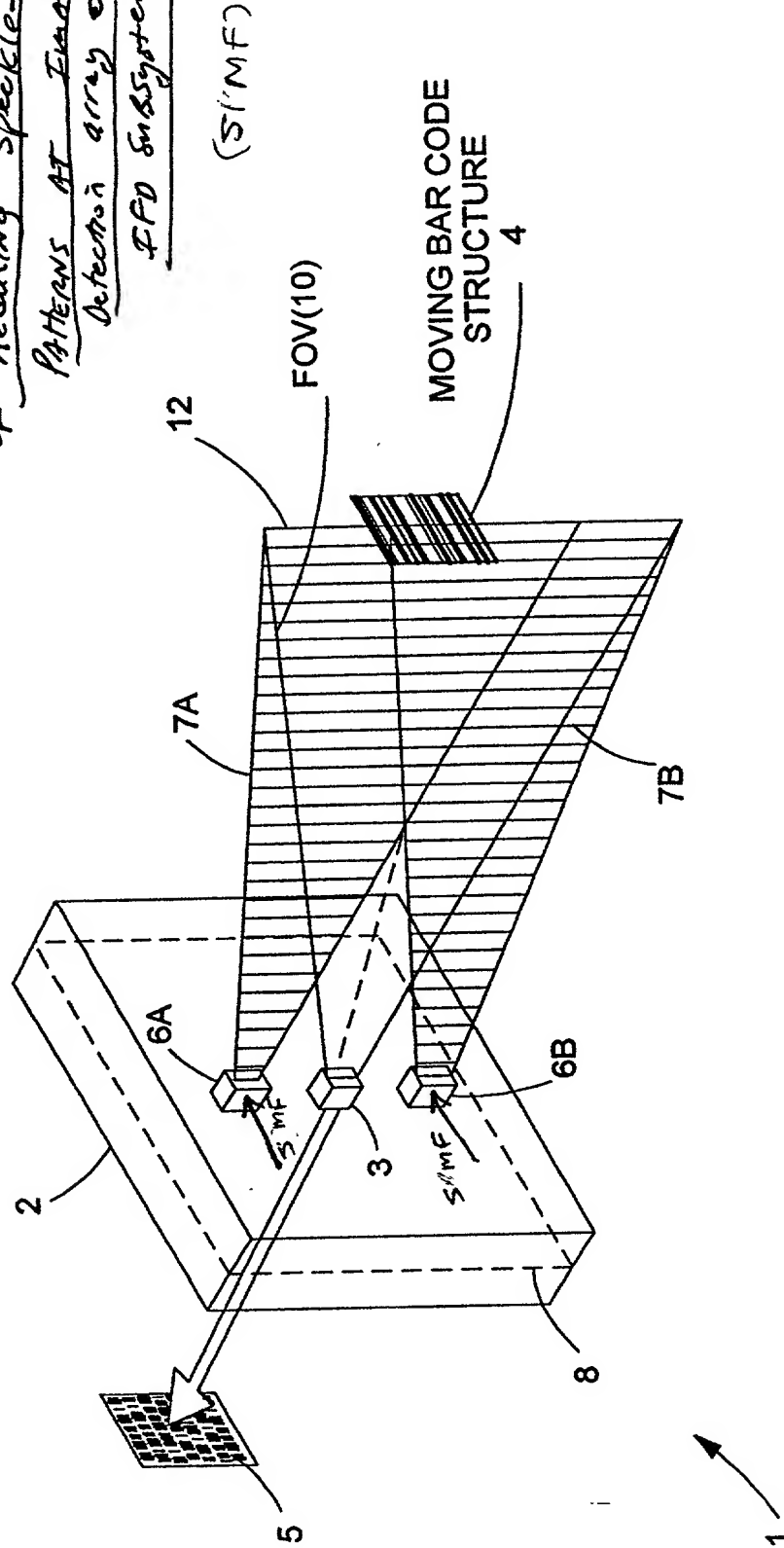


FIG 1F 20

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Fifth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the transmitted PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

↓

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG. 1I20B

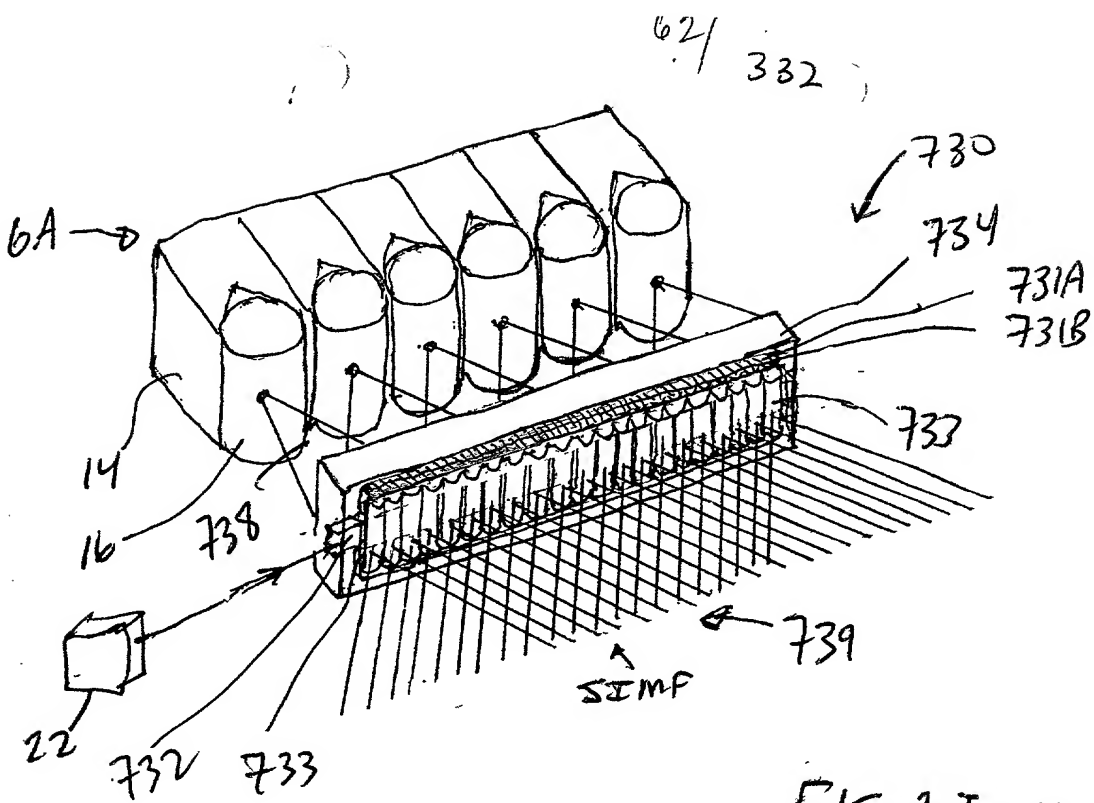


FIG. 1I2IA

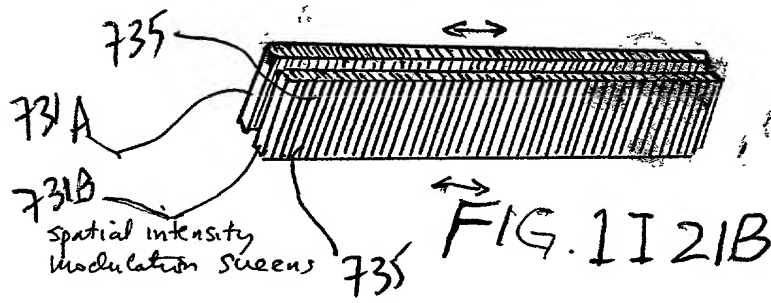


FIG. 1I2IB

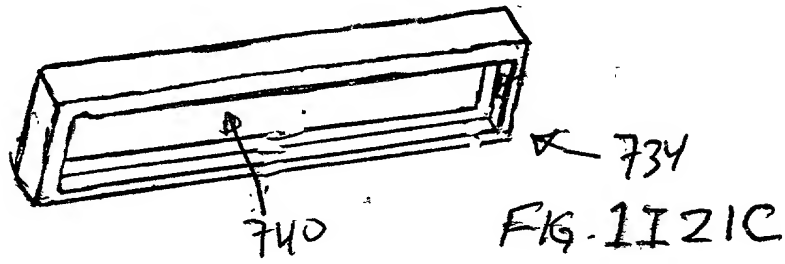


FIG. 1I2IC

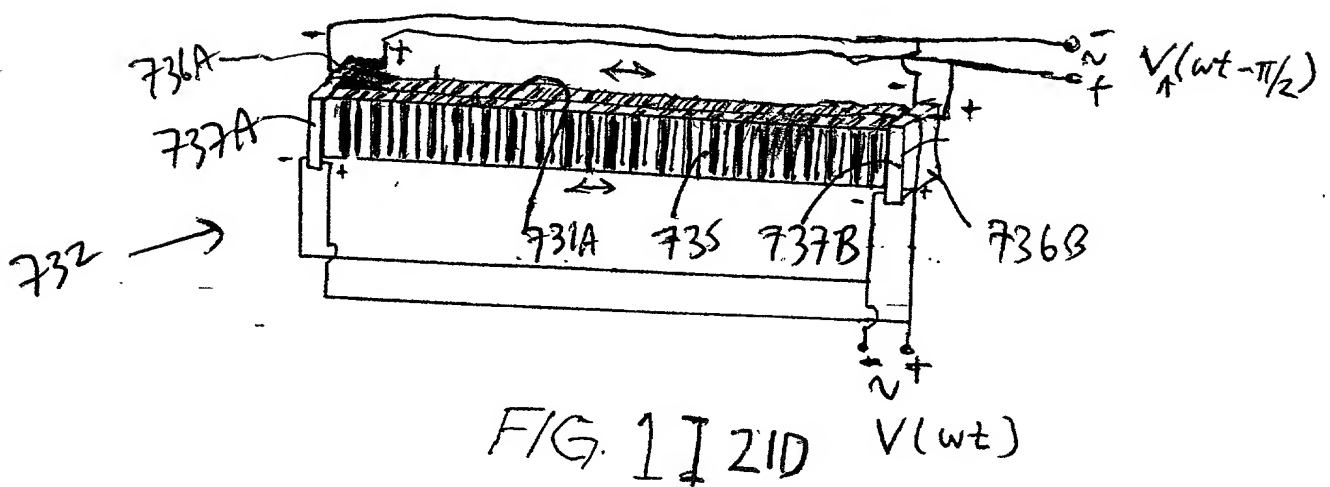


FIG. 1I2ID

Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection array
of the IFD Subsystem
(SIMF)

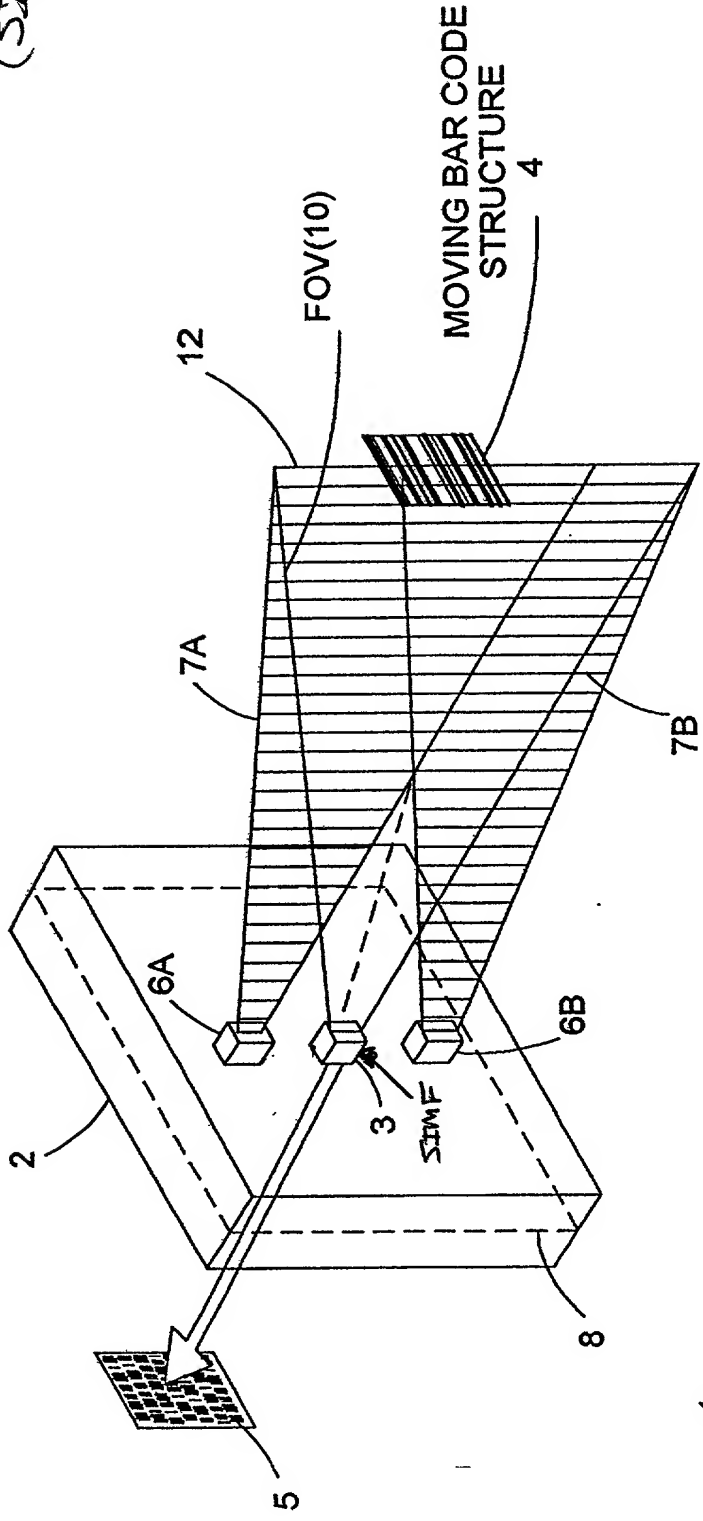


FIG. 1I 22

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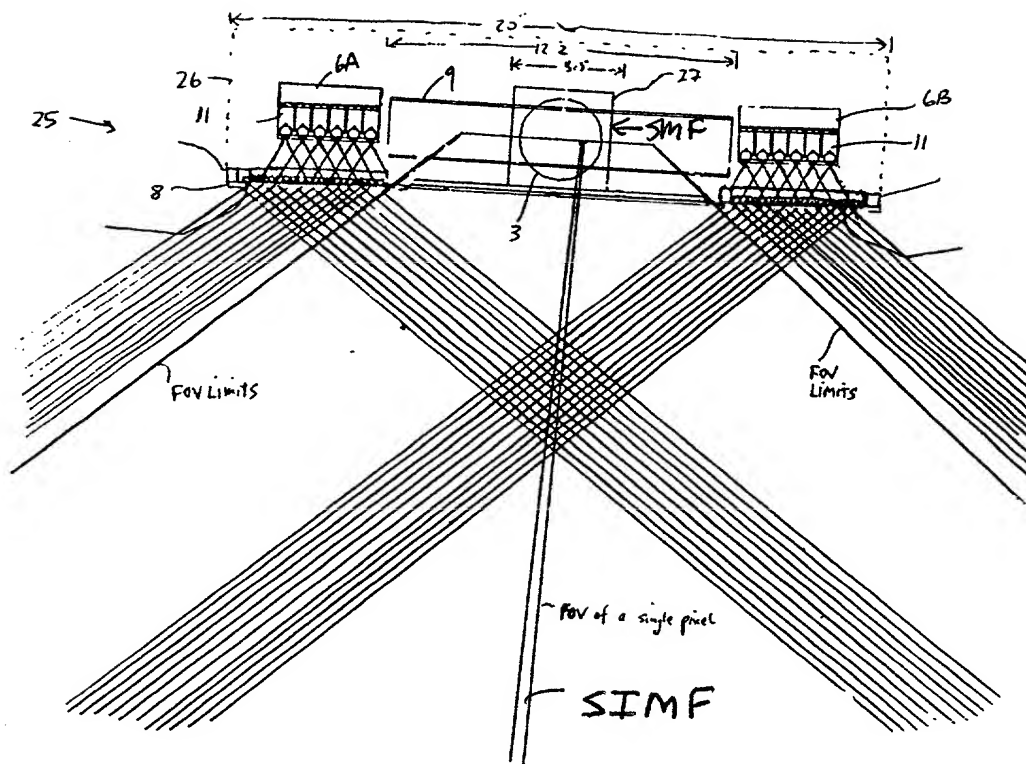


FIG. II 22A

Sixth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to .

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I 22B

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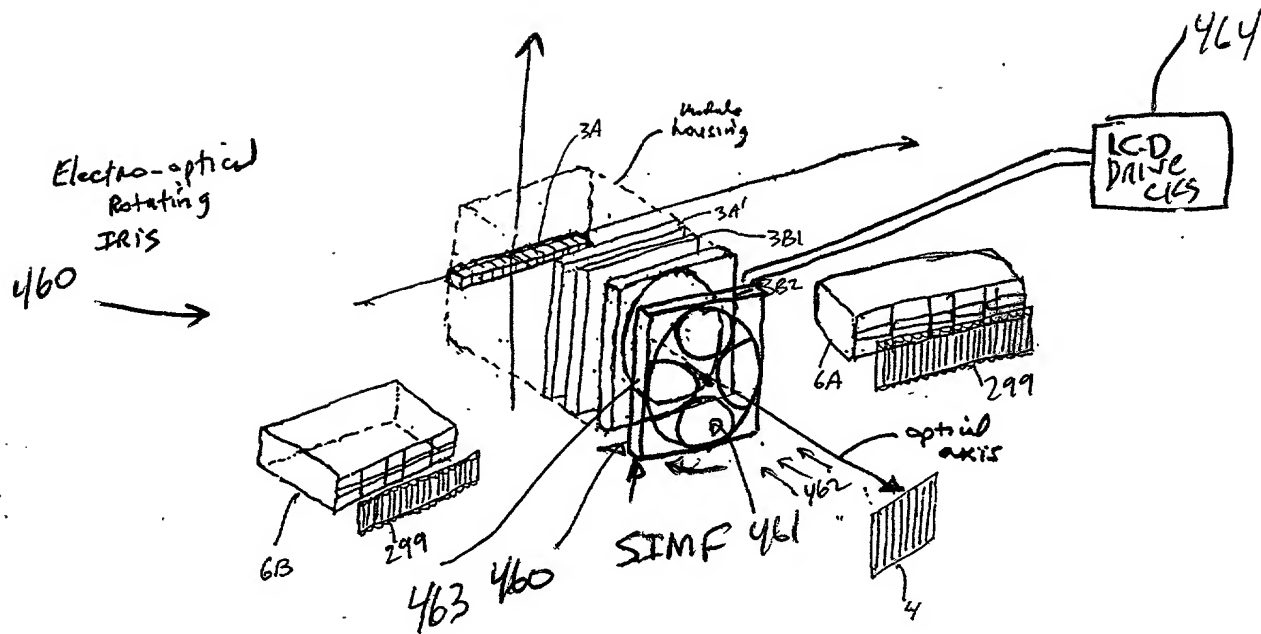


FIG. 1I 23A

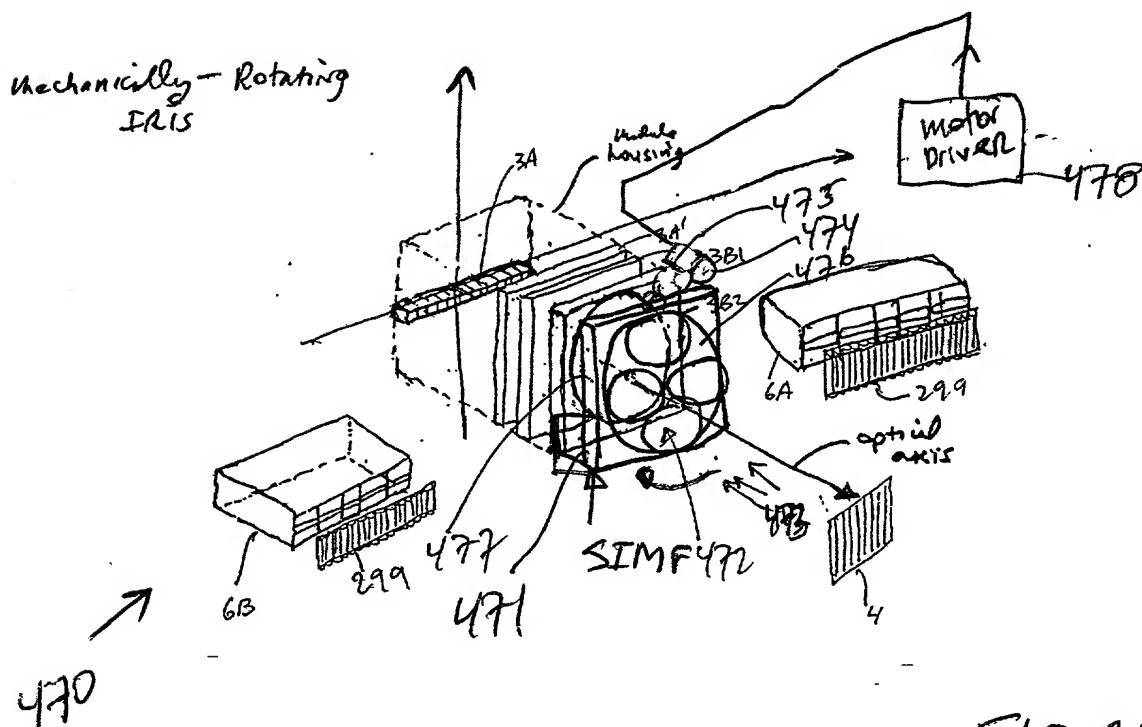


FIG. 1I 23B

Seventh Generalized Method of
Reducing Specle - Noise Patterns
at Image Detection Array
of 76 IFD Subsystem

(TIME)

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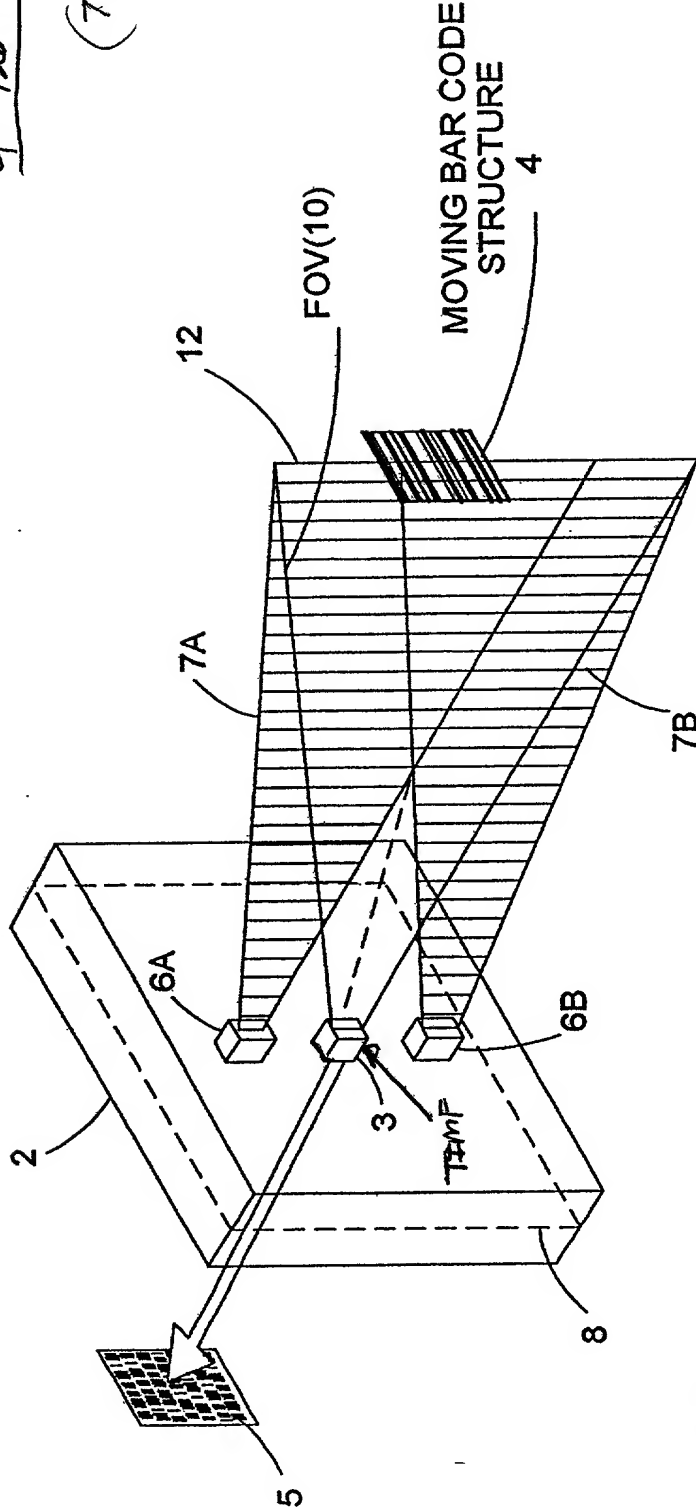


FIG. 1124

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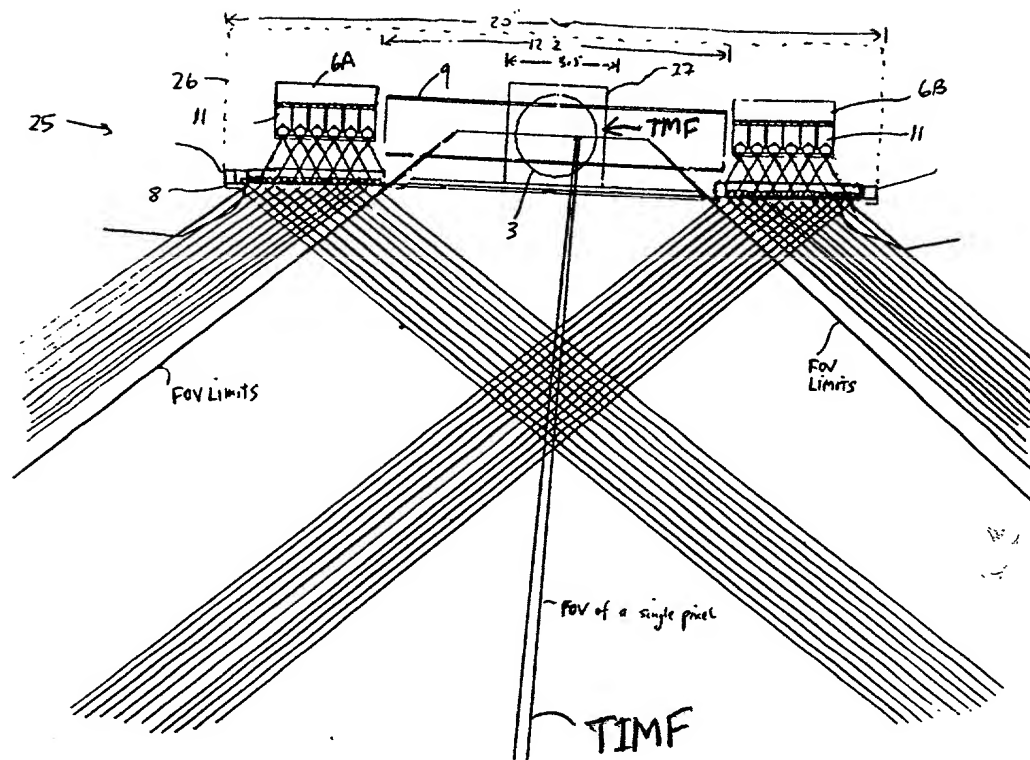


FIG. 1I24A

Seventh Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to

produce many substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I24B

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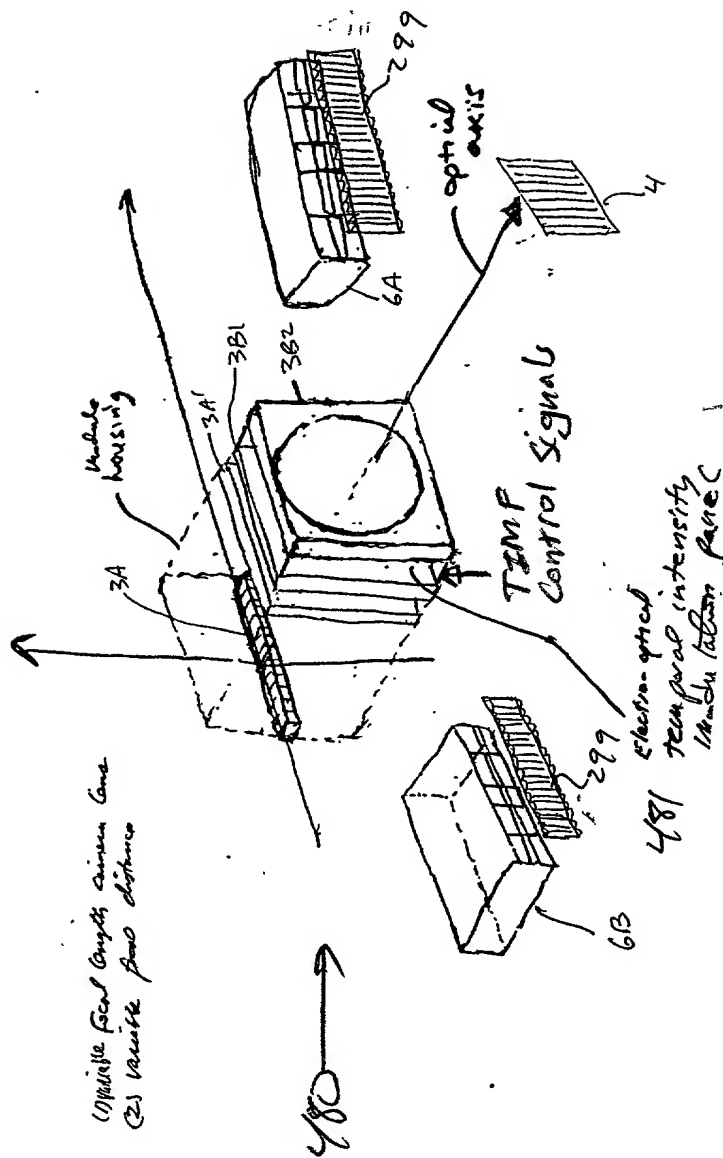
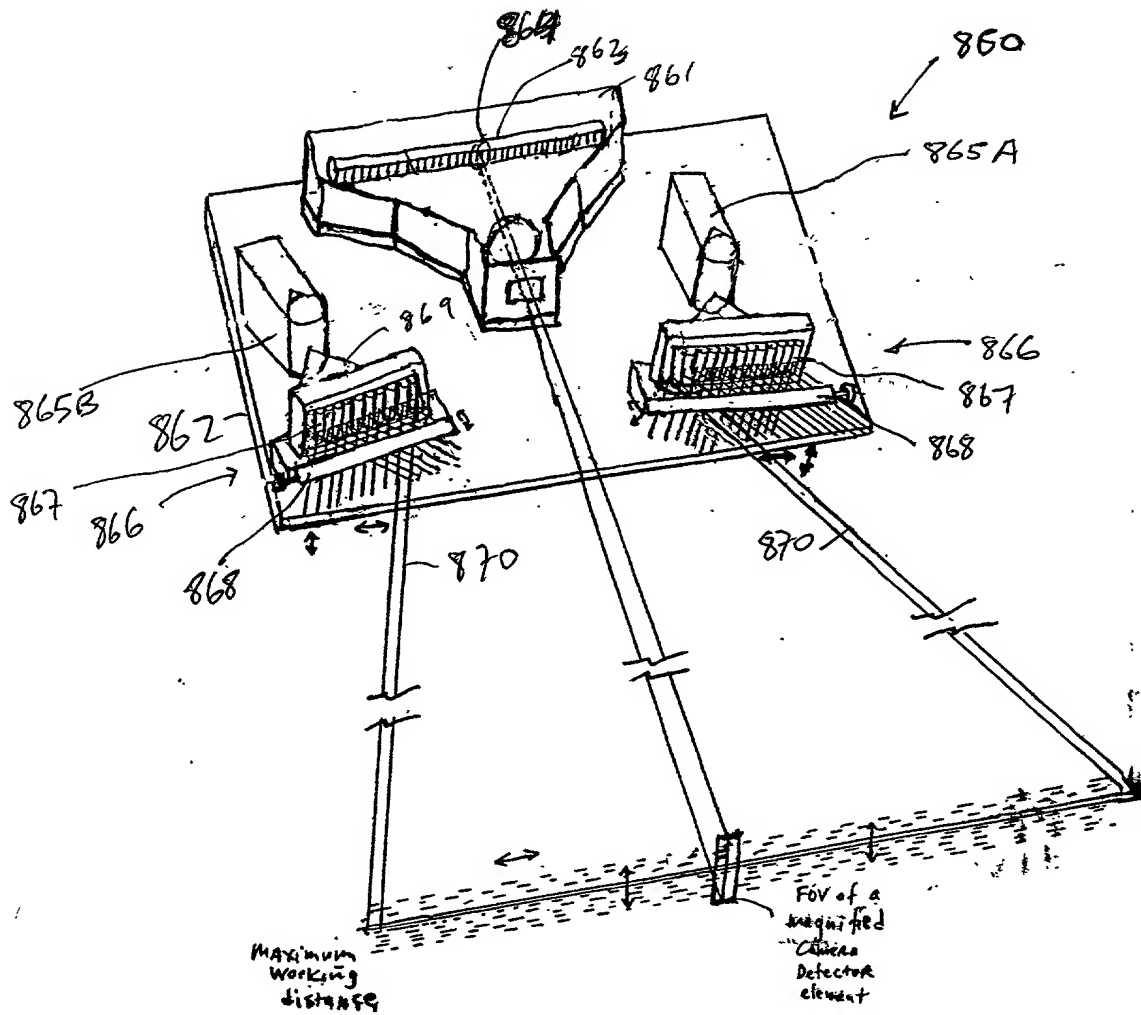


Fig. 11 Z4C

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* Lateral and Transverse Microoscillation of PLIB

FIG. 1I25A1

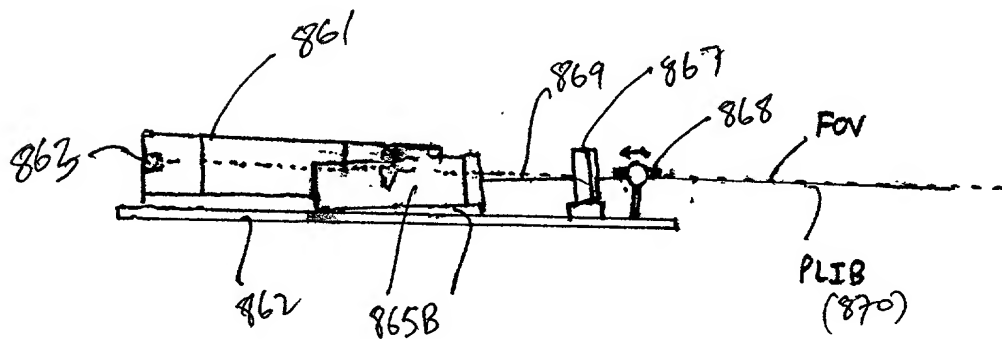


FIG. 1I25A2

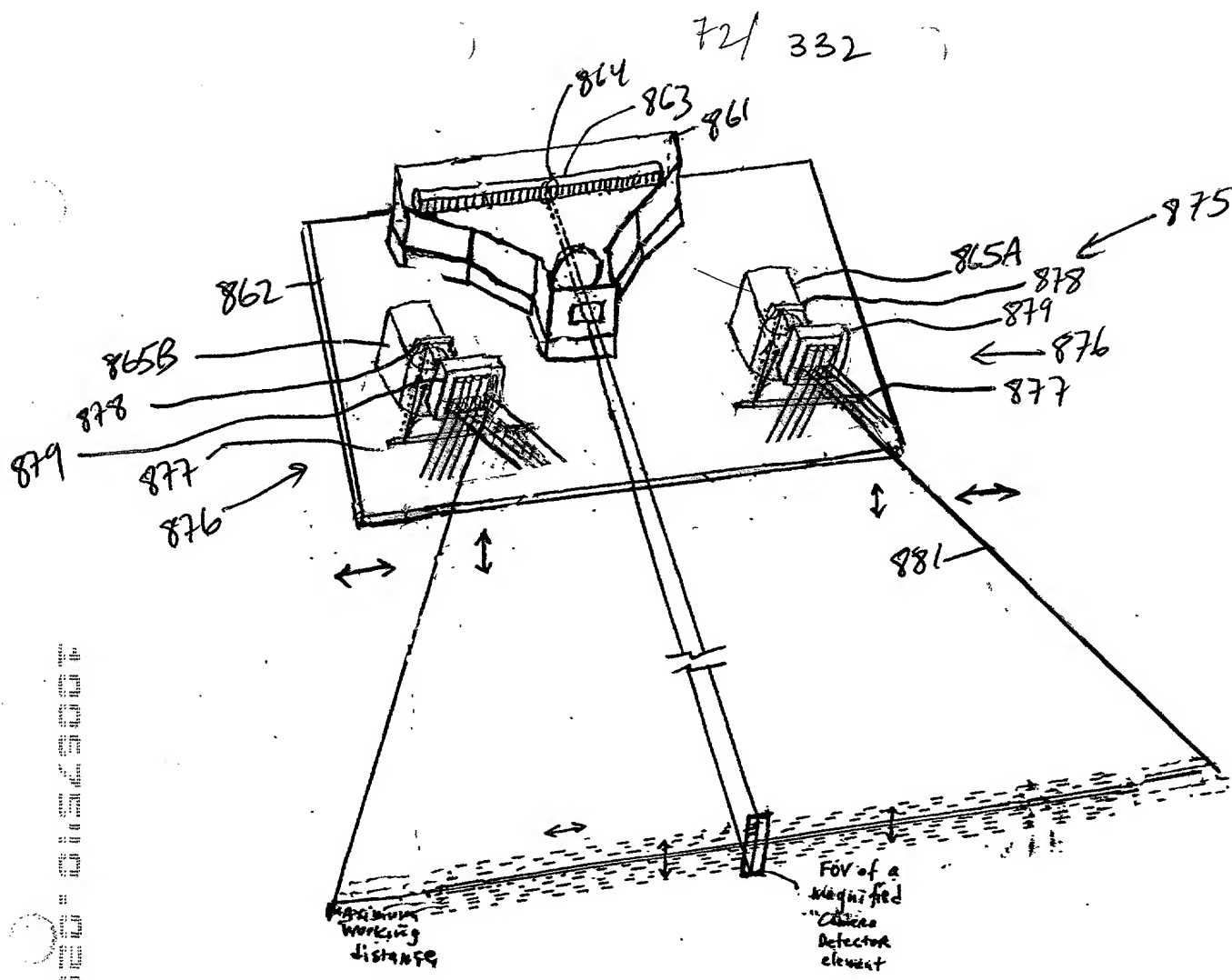


FIG. 1 I 25 B 1

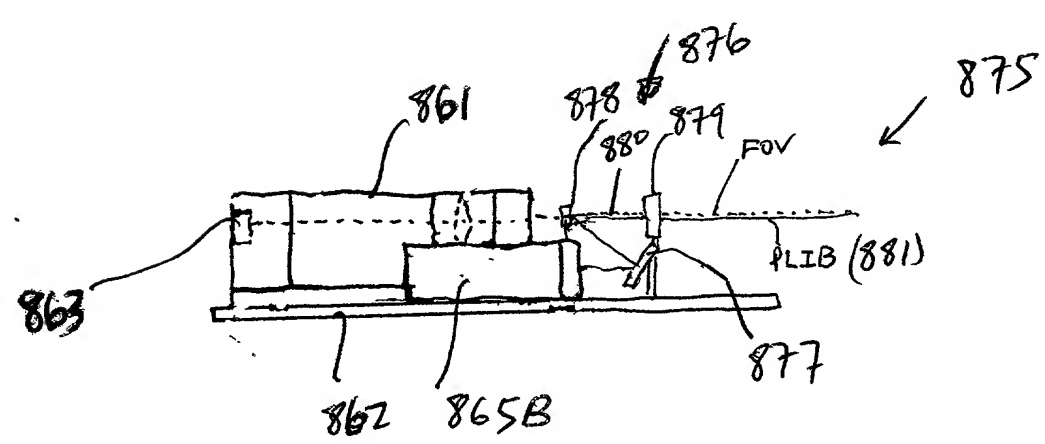
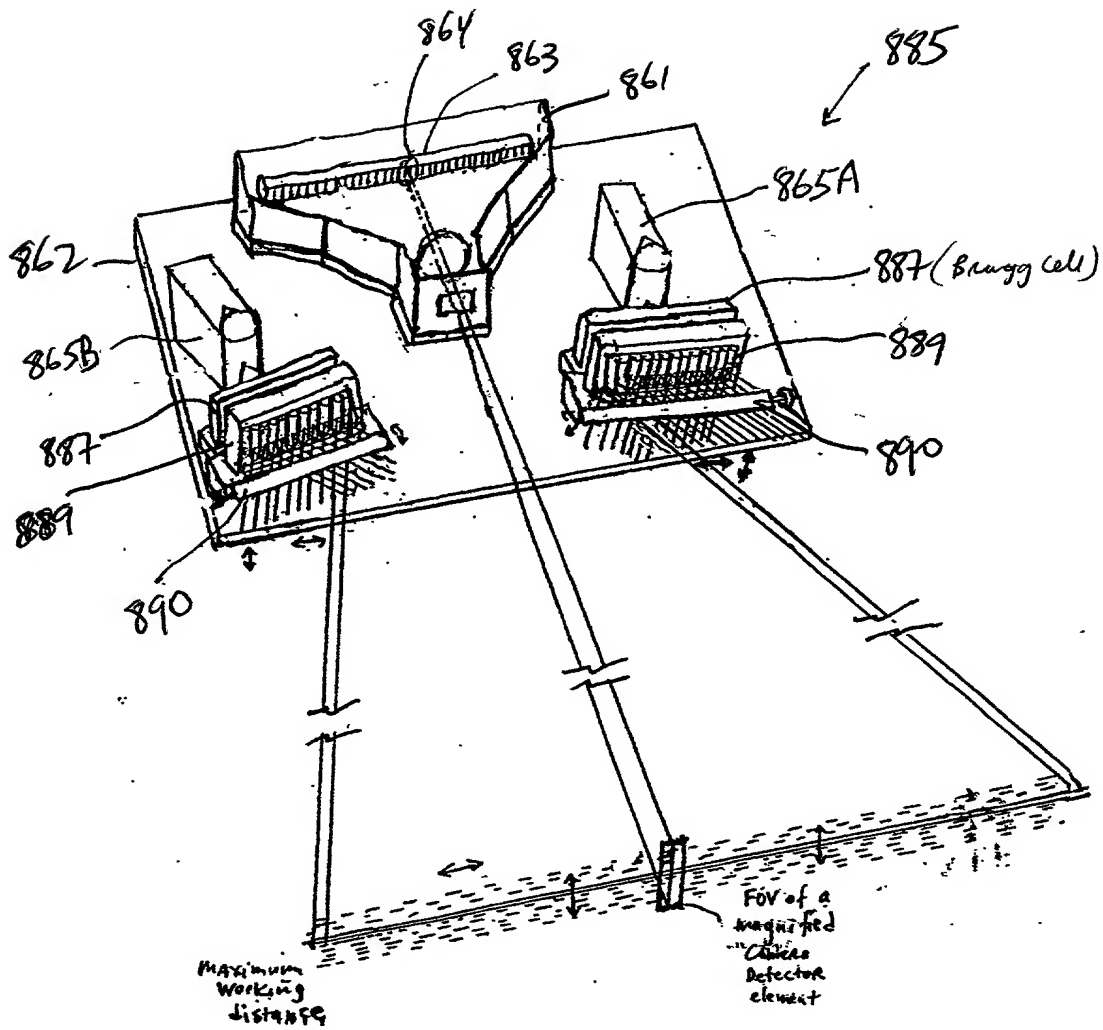


FIG. 1 I 25 B 2



* Lateral and Transverse Maxioscillation of PLIB

FIG. 1I25C1

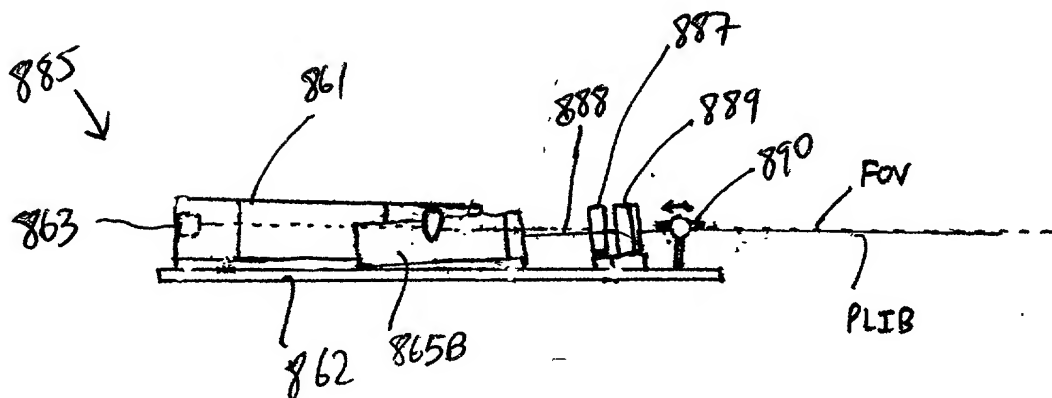


FIG. 1I25C2

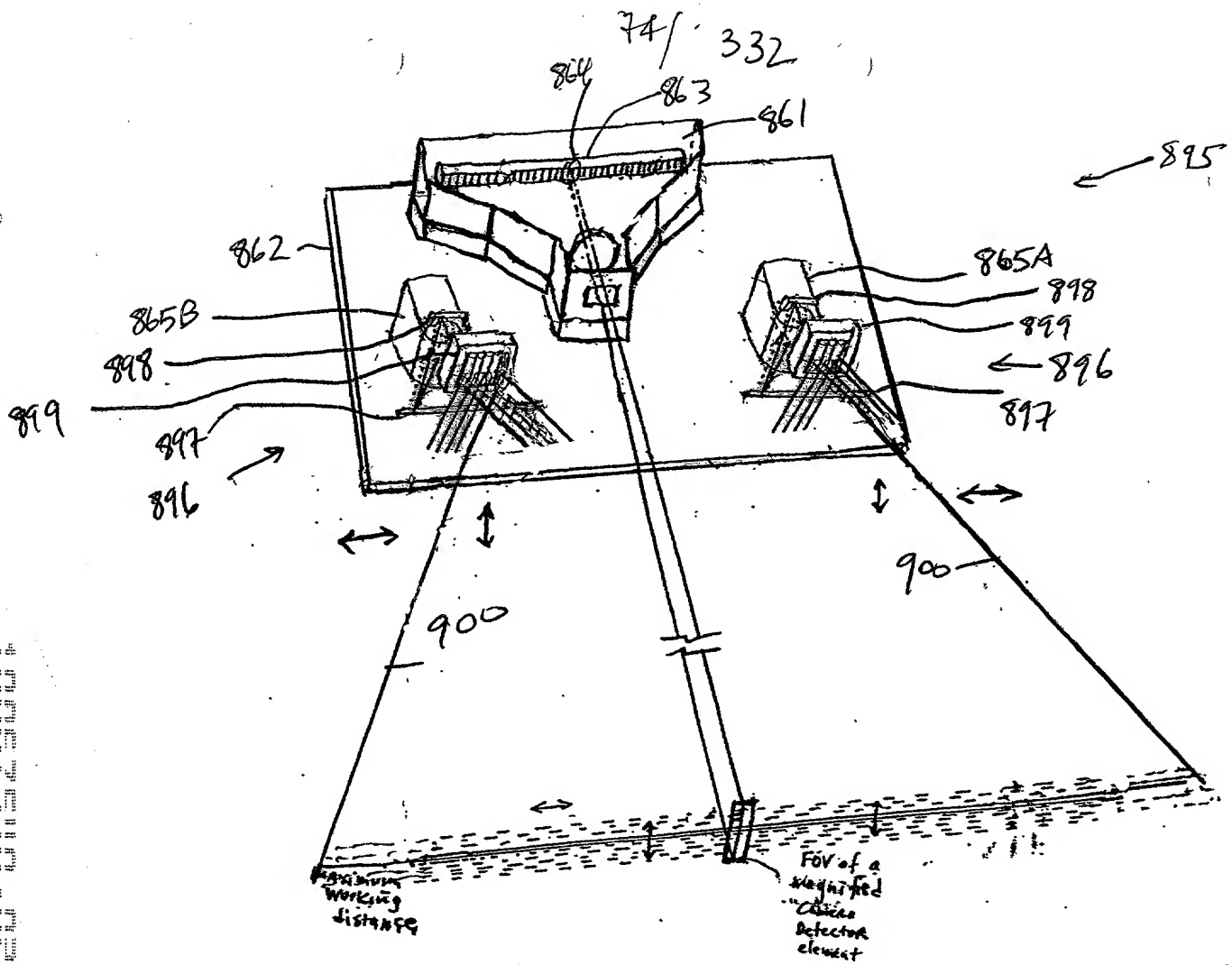


FIG. 1 I 25 D1

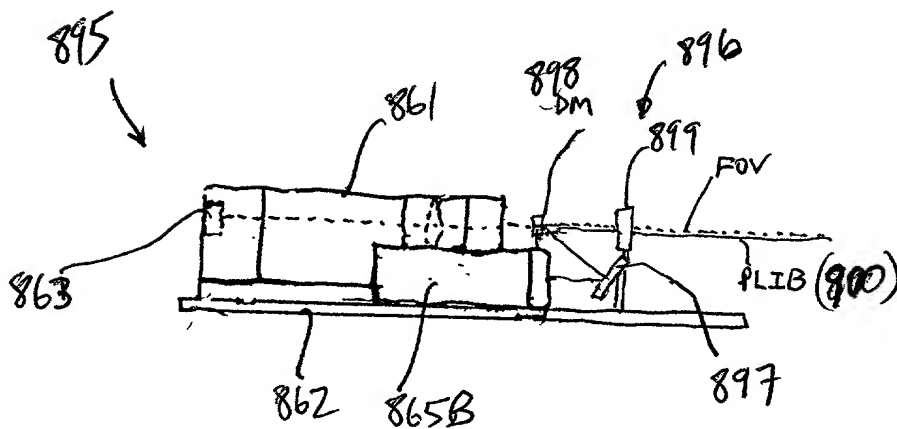
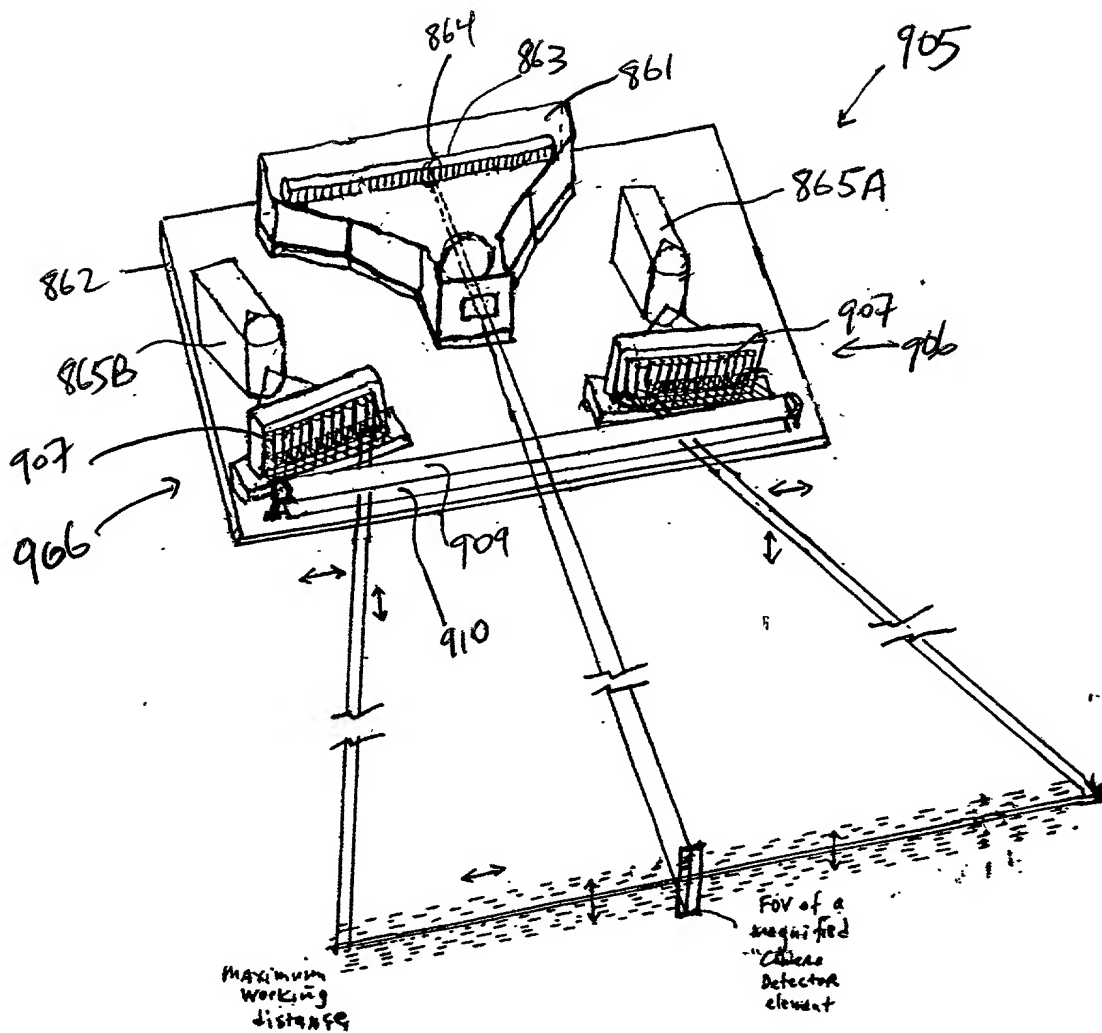


FIG. 1 I 25 D2



* Lateral and Transverse Microoscillation of PLIB

905

FIG. 1I25E1

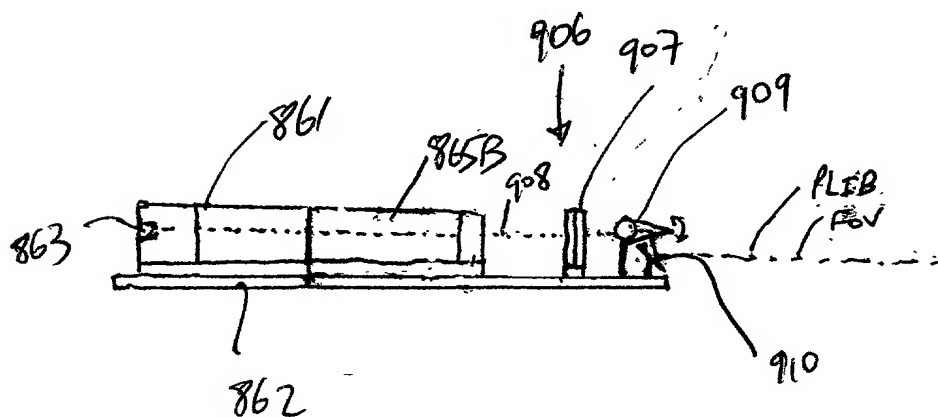


FIG. 1I25E2

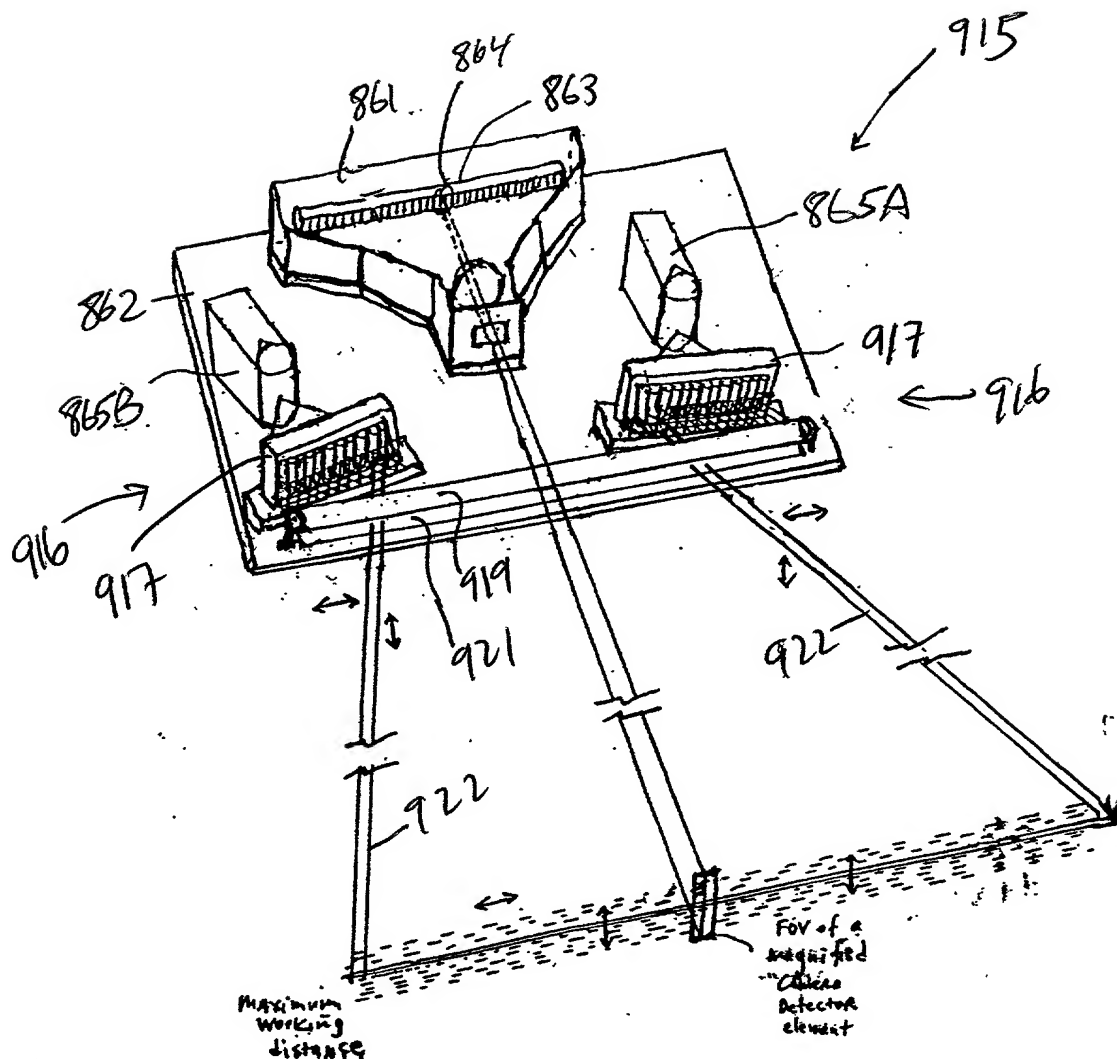


FIG. 1I25F1

* Lateral and Transverse Microoscillation of PLIB

915

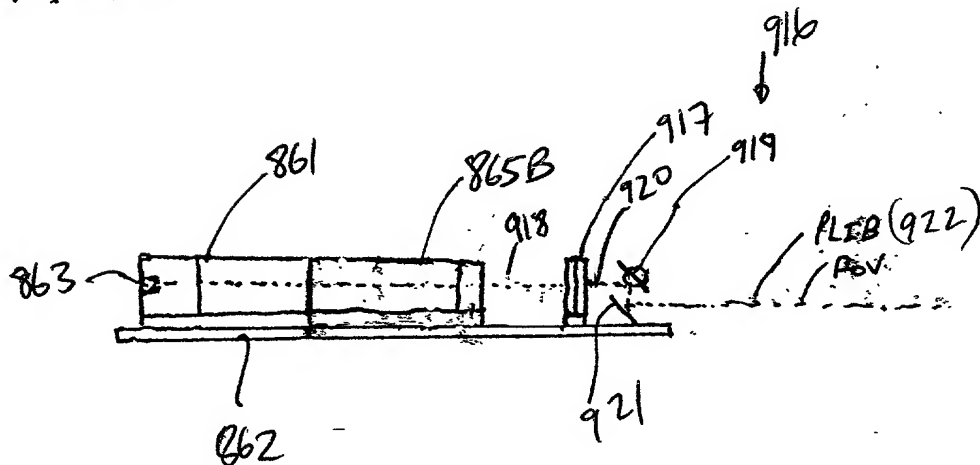
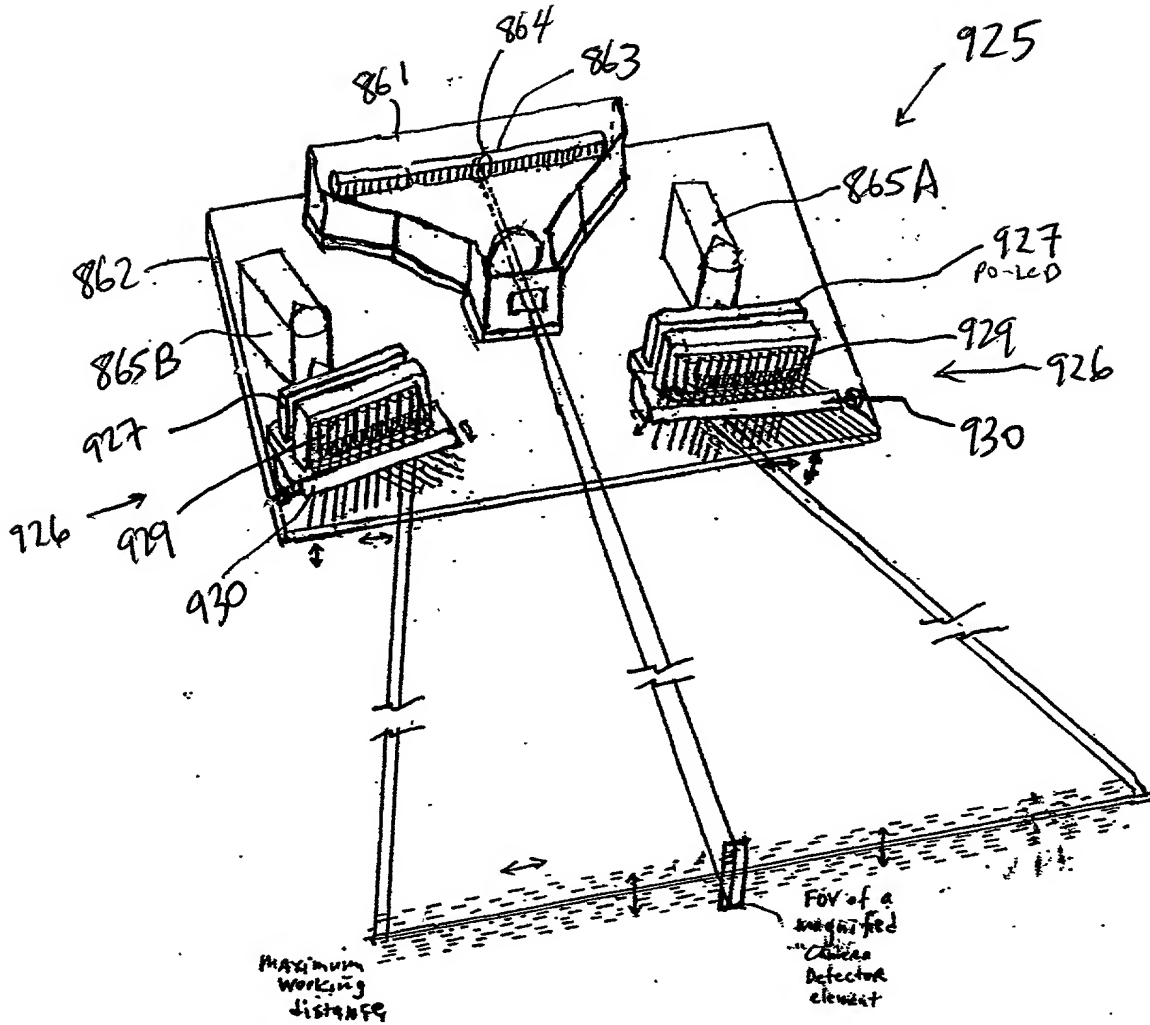


FIG. 1I25F2

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* Lateral and Transverse Microoscillation of PLIB

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FIG. 1I25G1

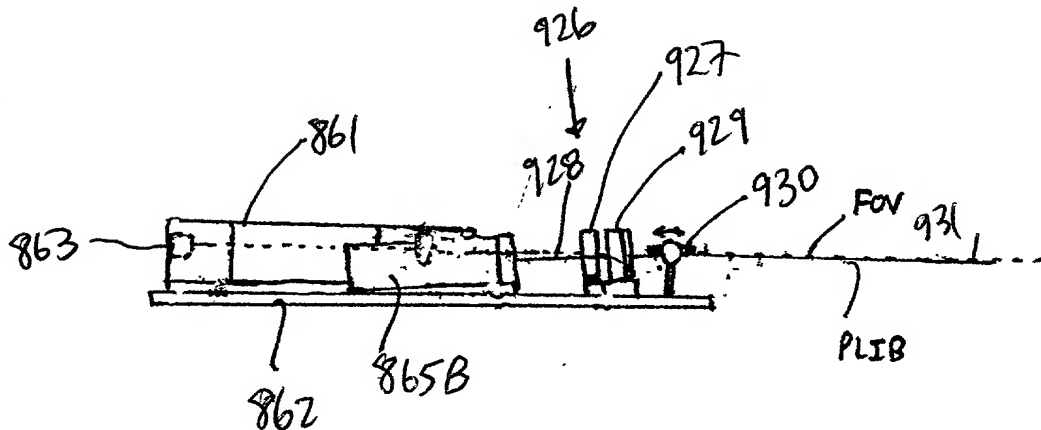
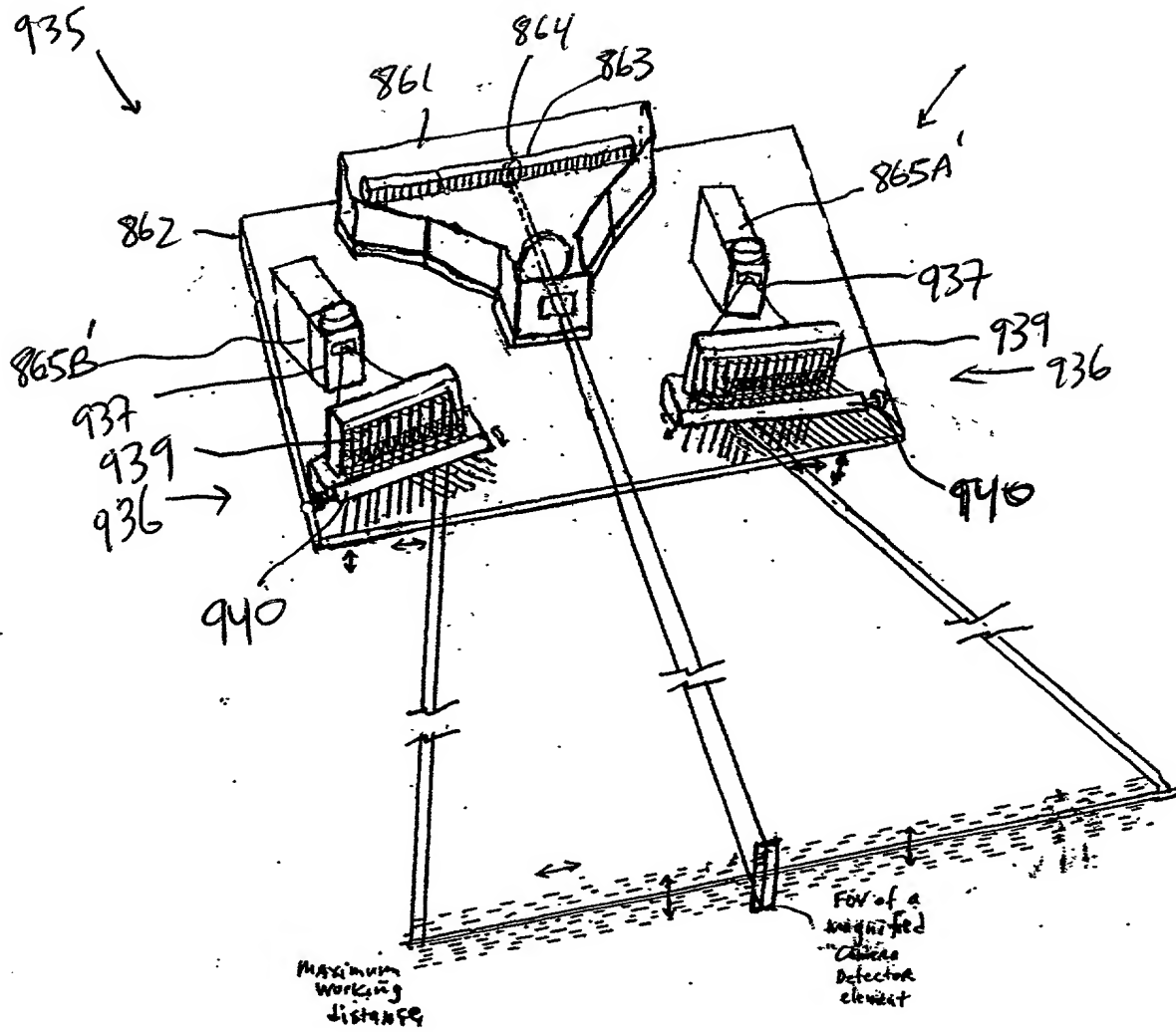


FIG. 1I25G2

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* Lateral and Transverse Microoscillation of PLIB

FIG. 1I25H1

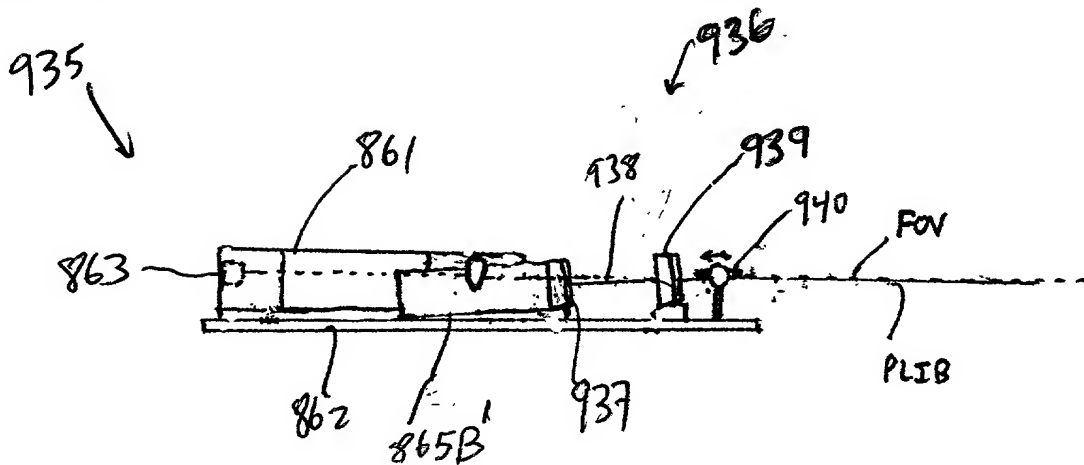
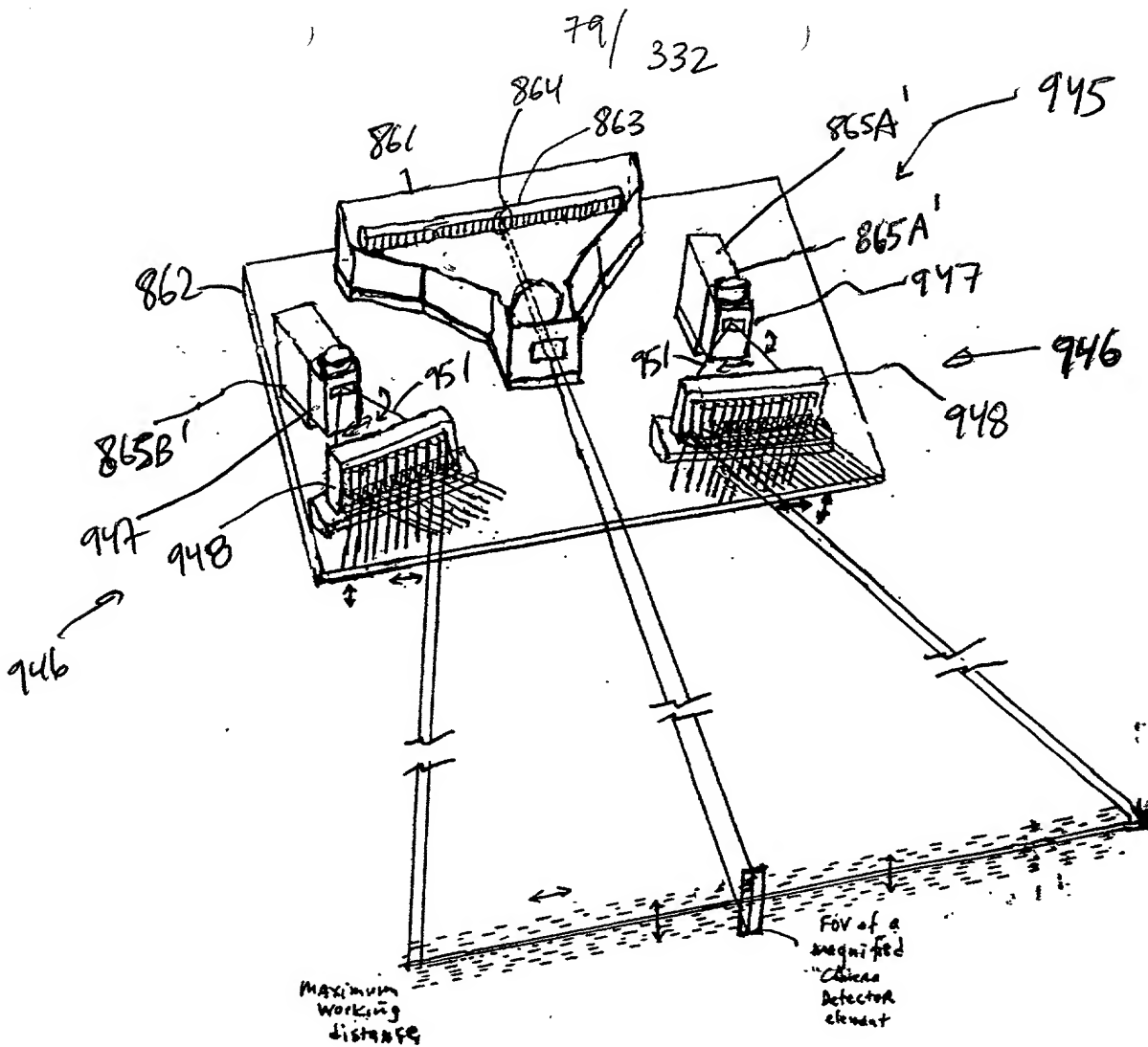


FIG. 1I25H2



Lateral and
Transverse
Magnification of PLIB

FIG. 1I25I1

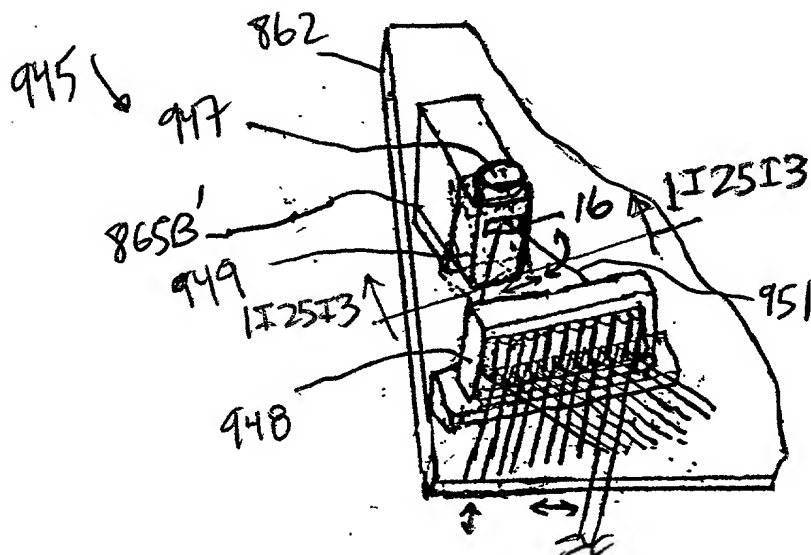


FIG. 1I25I2

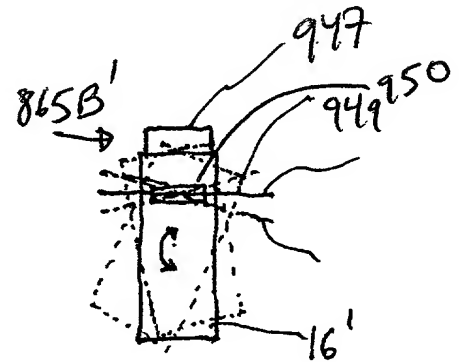


FIG. 1I25I3

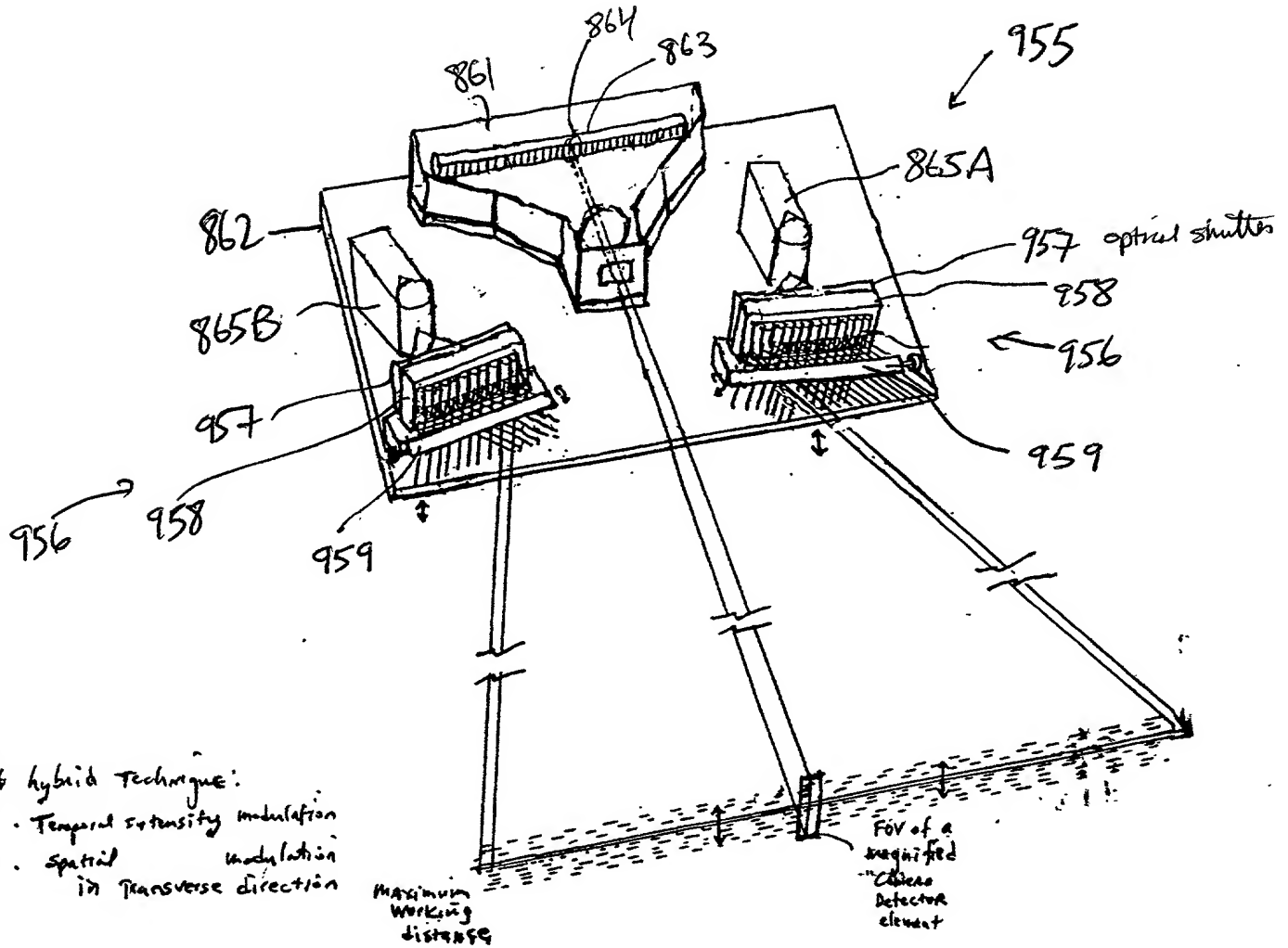


FIG. 1I25J1

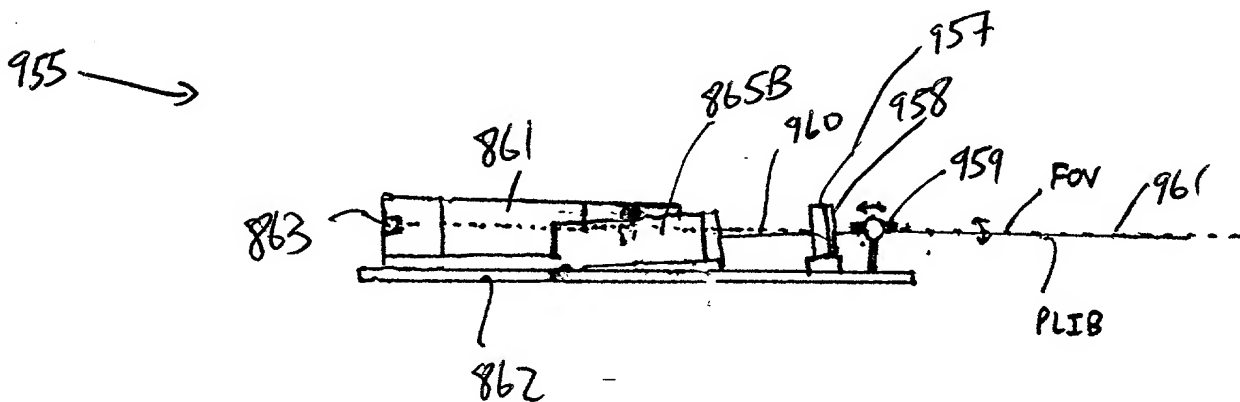


FIG. 1I25J2

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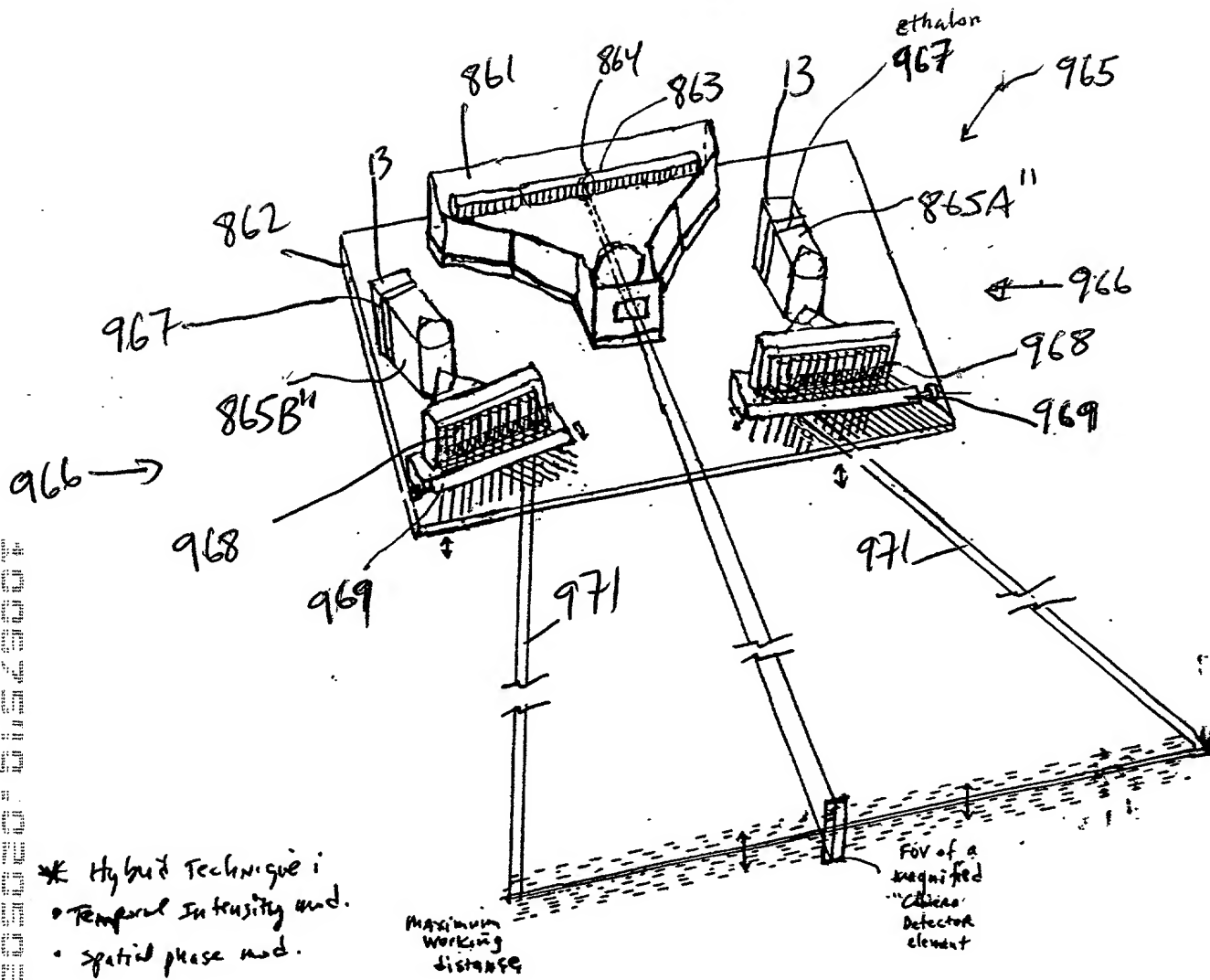


FIG. 1I25K1

* Transverse
 Modulation of PLIB

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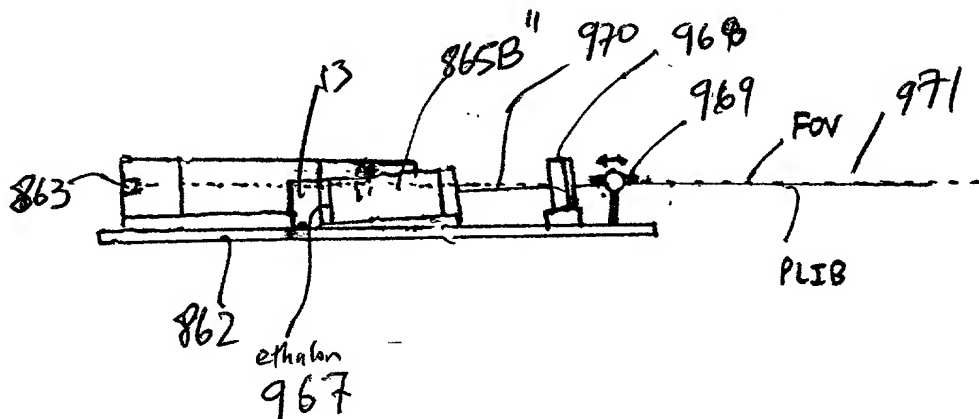
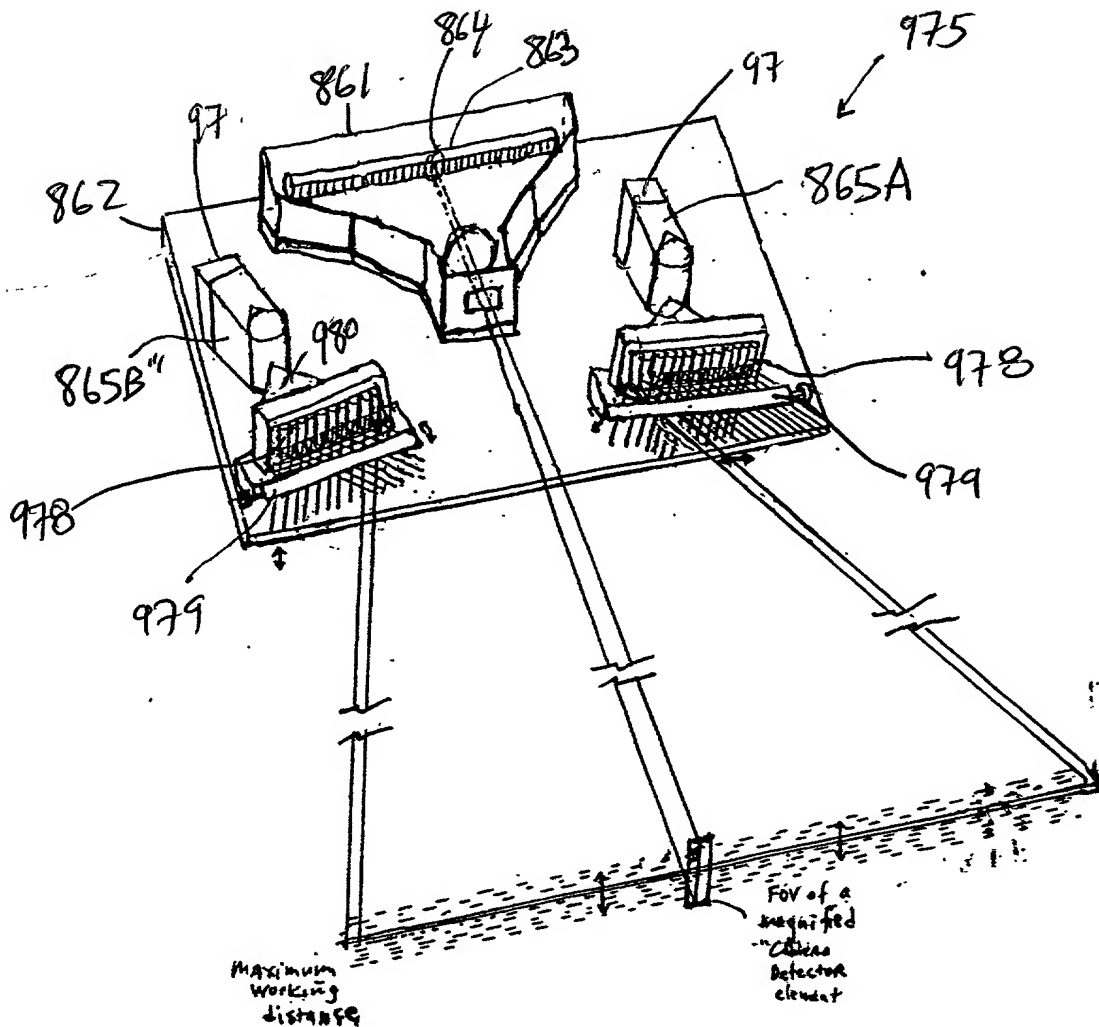


FIG. 1I25K2



* hybrid =
 • Temp. freq. mod.
 • Spatial phase mod.

* Transverse
 Microoscillation of PLIB

FIG. 1I25L1

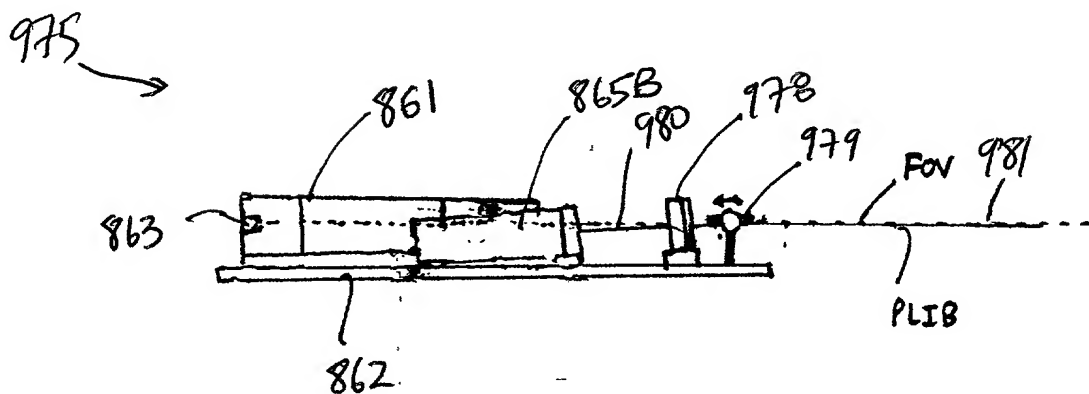
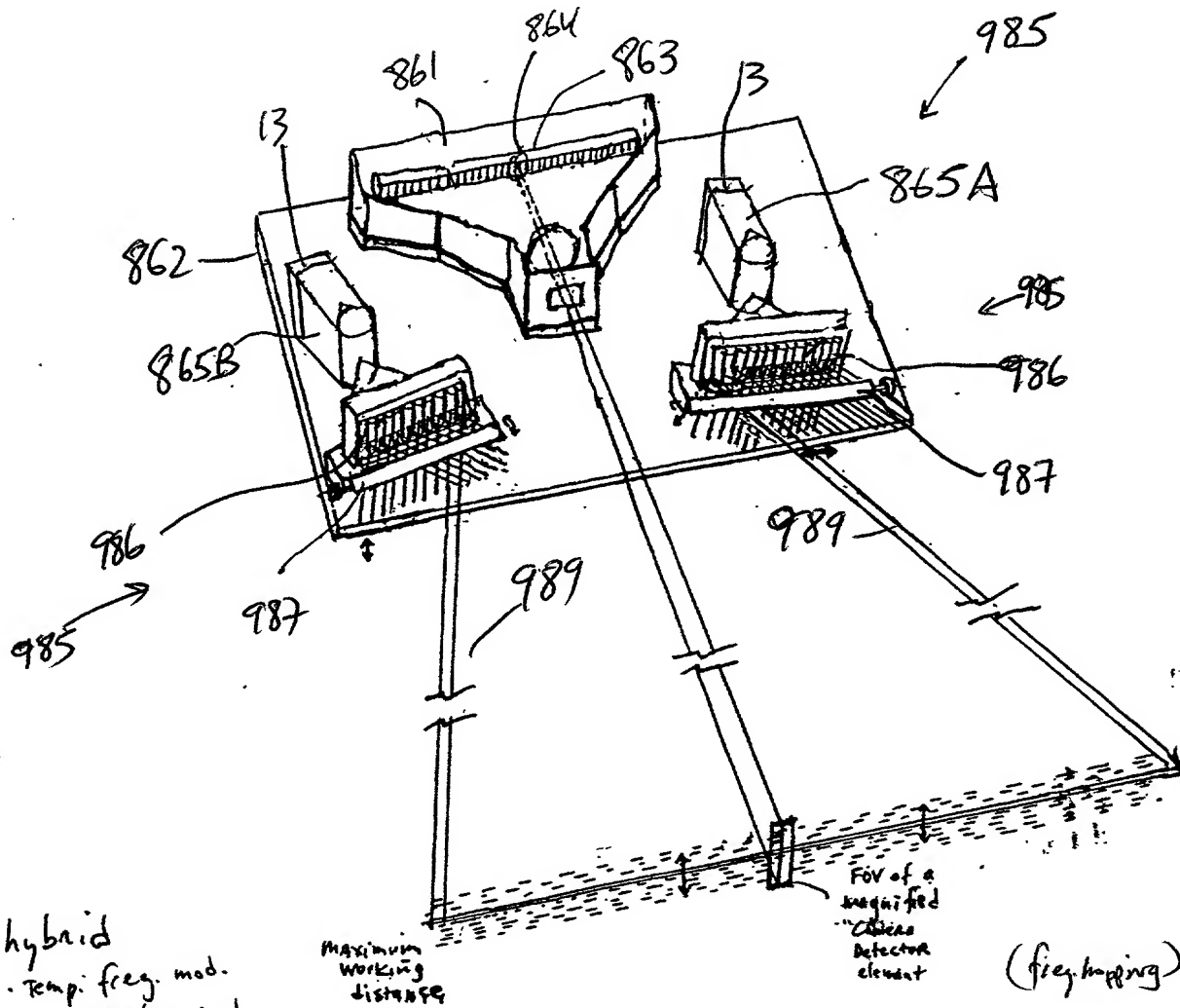


FIG. 1I25L2

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* hybrid
 • Temp. freq. mod.
 • Spatial phase mod.

FIG. 1I25M1

* Transverse
 Microoscillation of PLIB

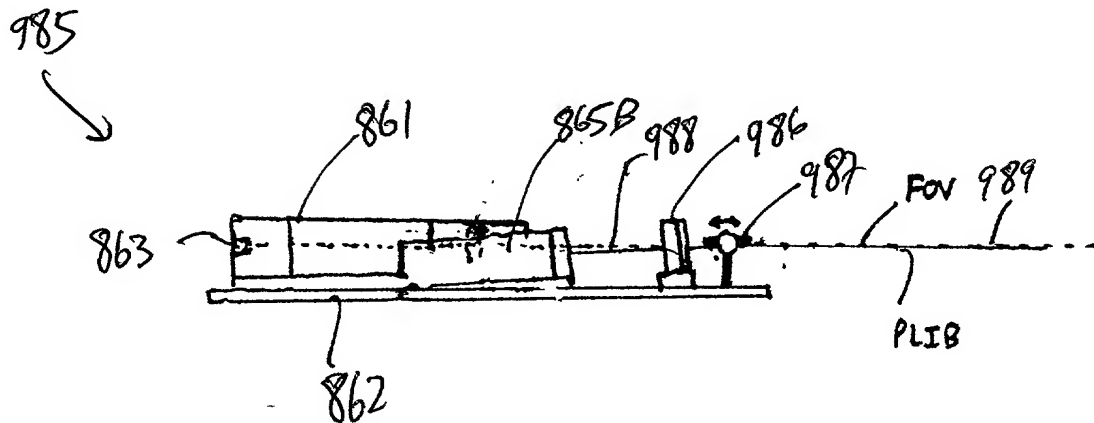
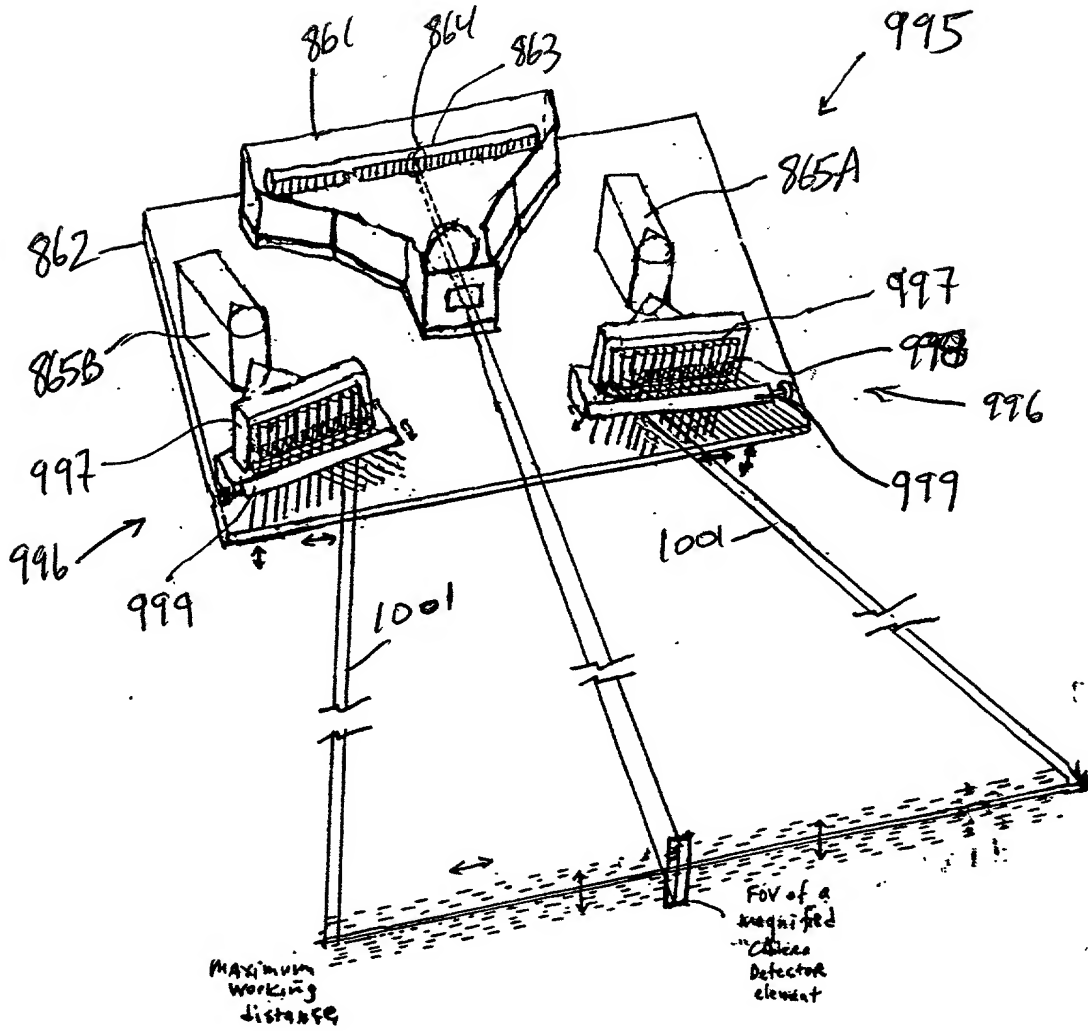


FIG. 1I25M2

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- * hybrid:
 - spatial intensity mod.
 - spatial phase

* Lateral and Transverse Microoscillation of PLIB

FIG. 1I25N1

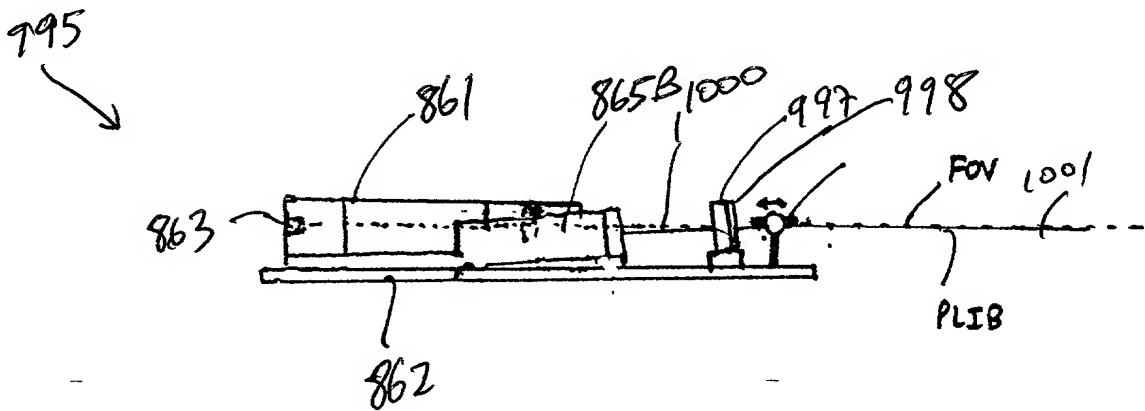


FIG. 1I25NZ

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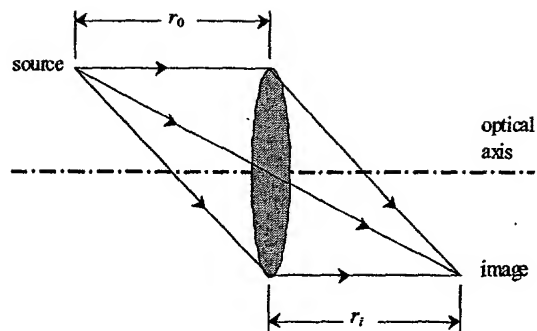


FIG. 1H1

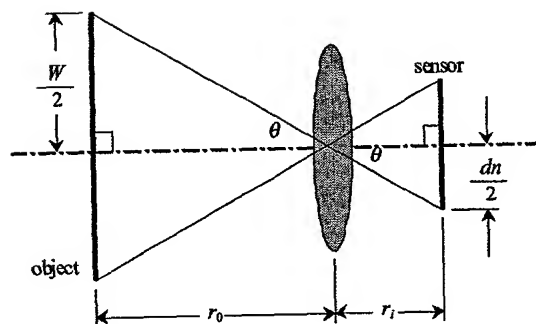


FIG. 1H2

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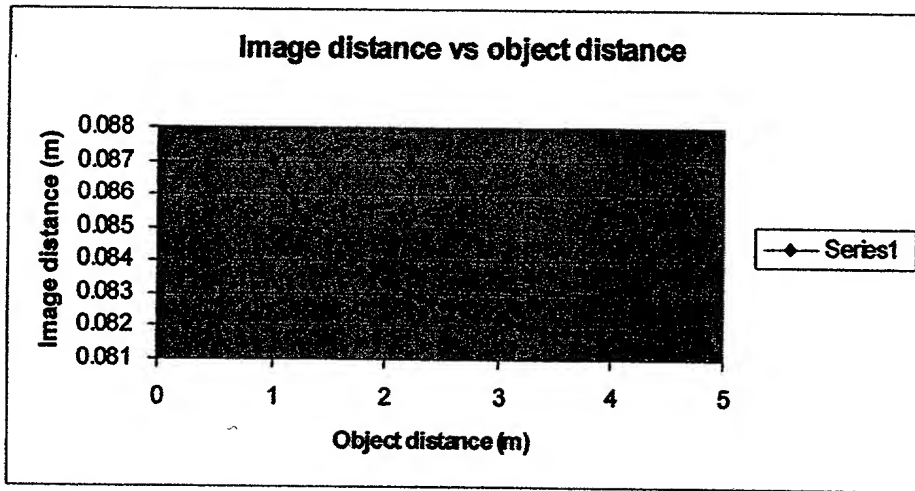


FIG. 1H3

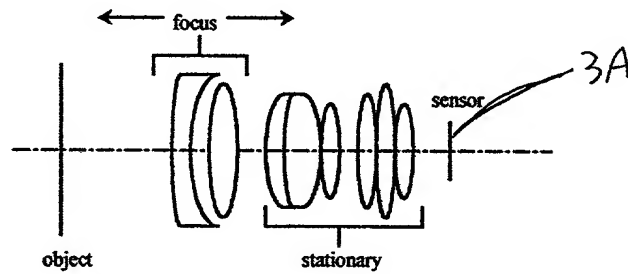


FIG. 1H4

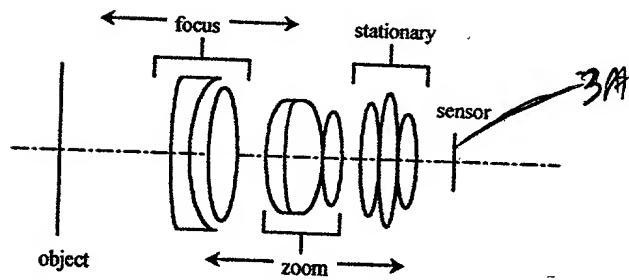


FIG. 1H5

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Fixed focal length lens cases

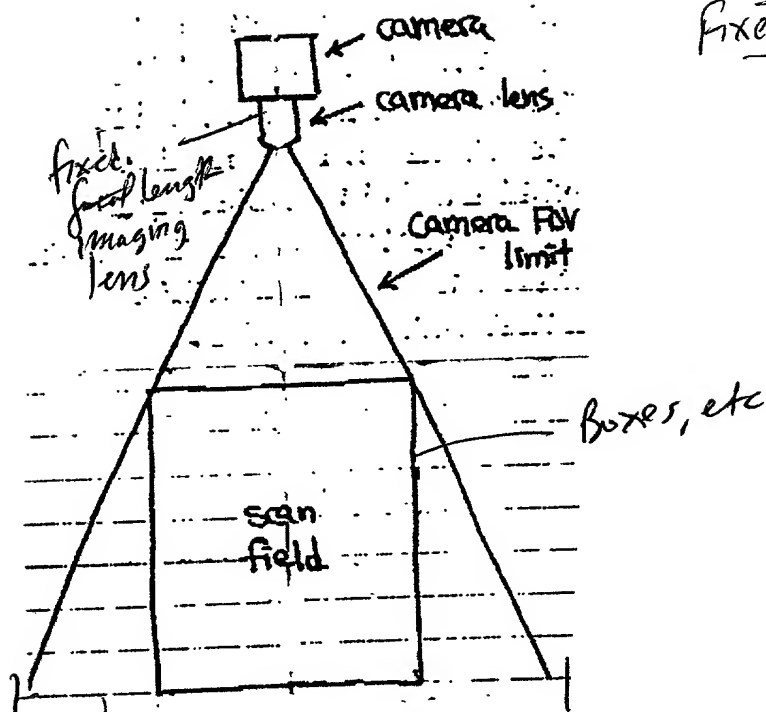


FIG. 1K1

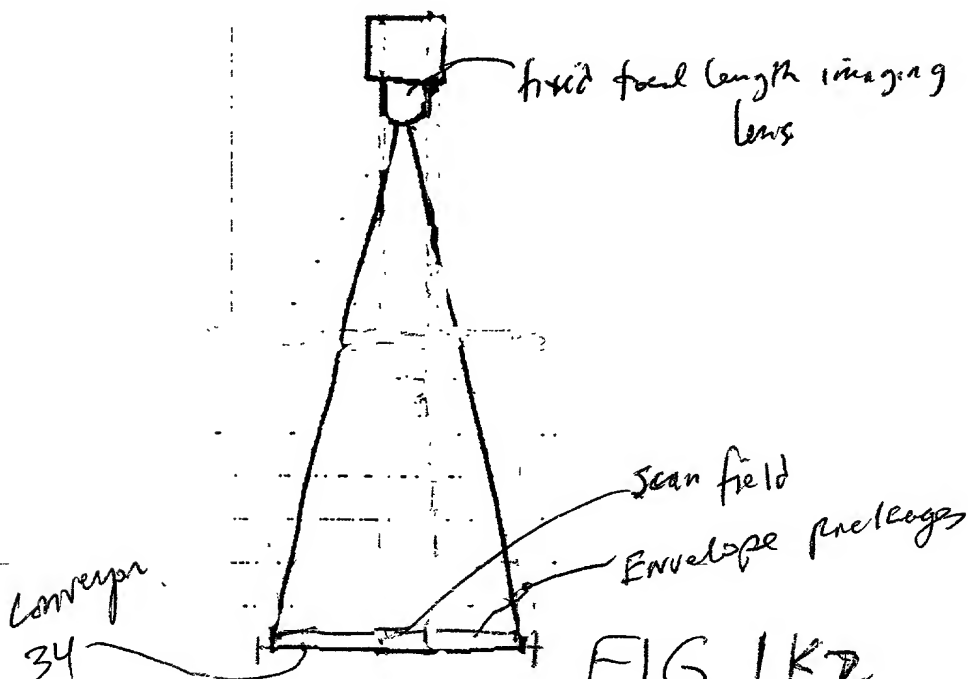


FIG. 1K2

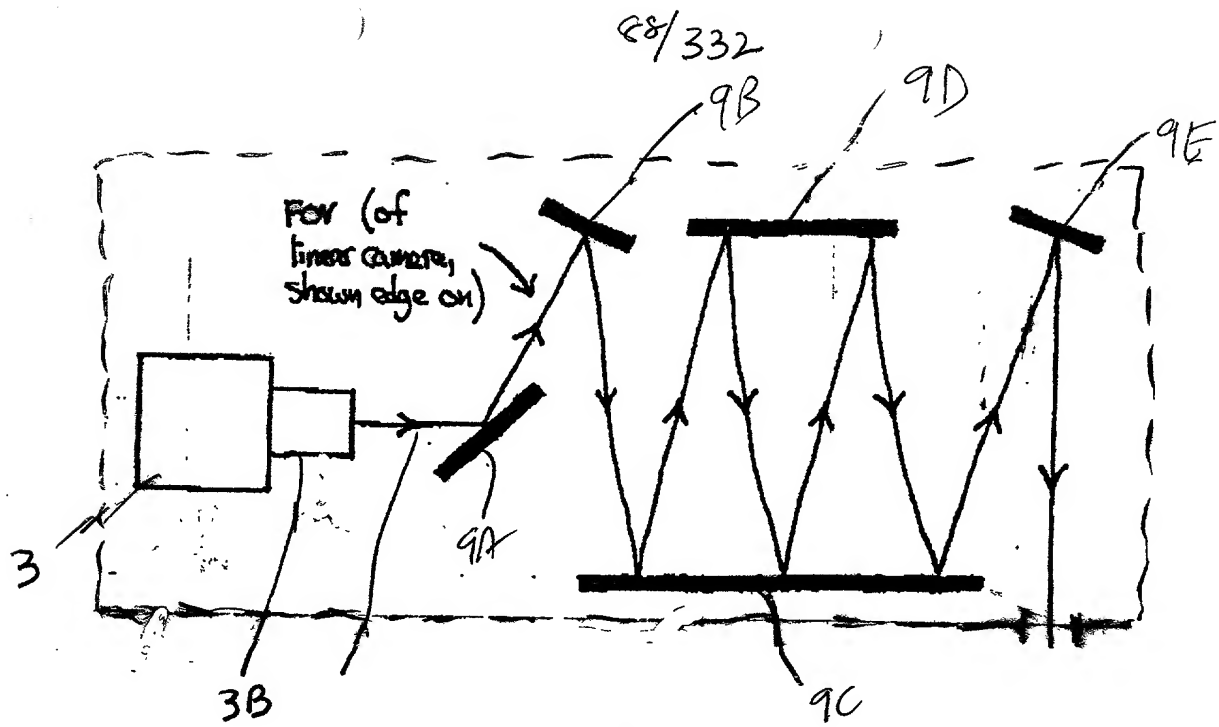


FIG. 1L1

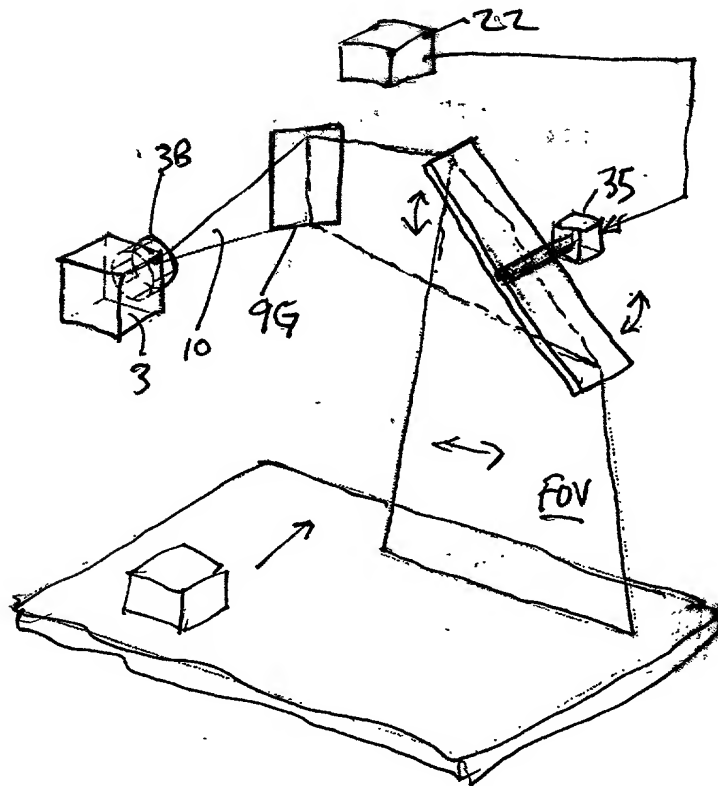


FIG. 1L2

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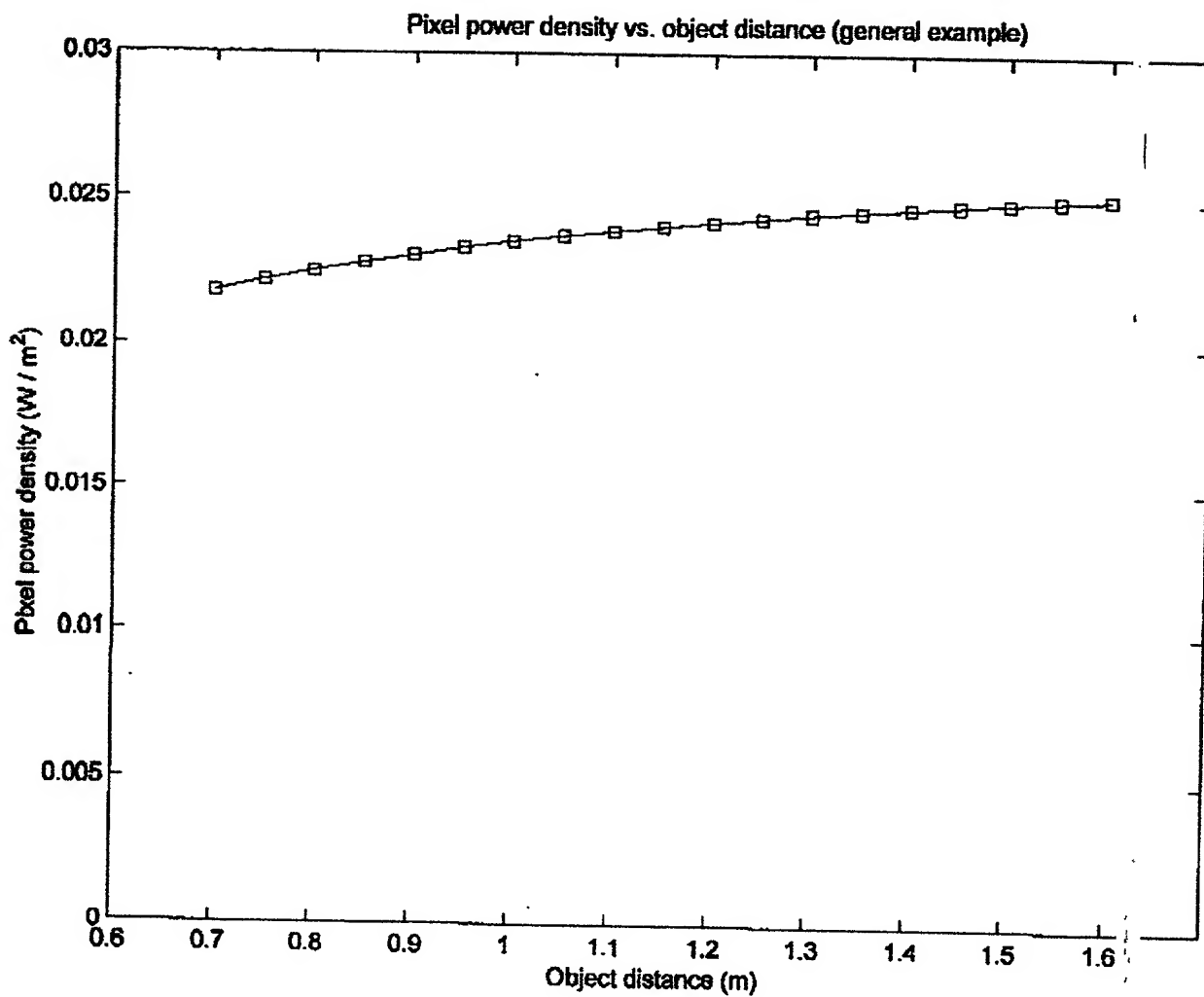


FIG-1M1

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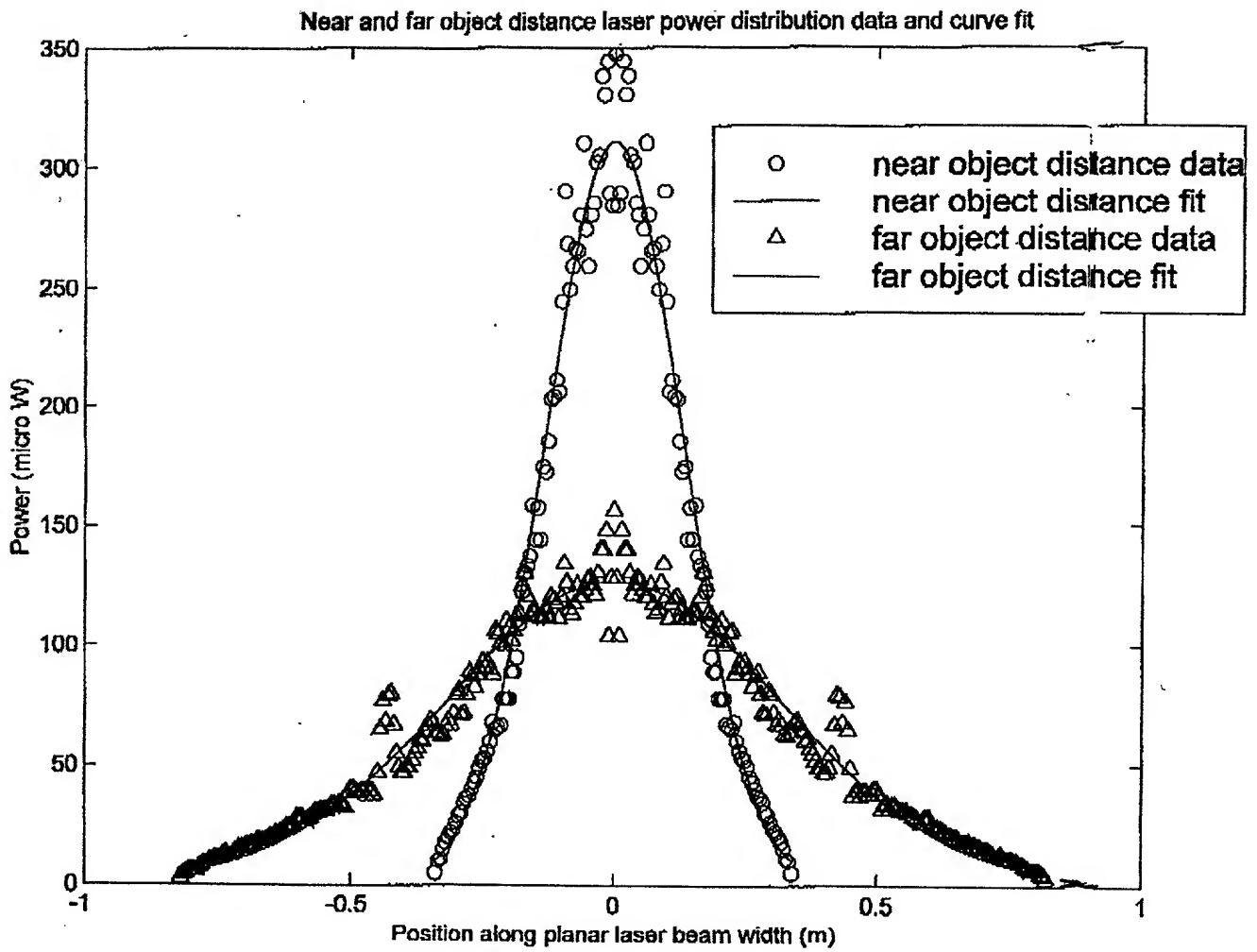


FIG. 1M2

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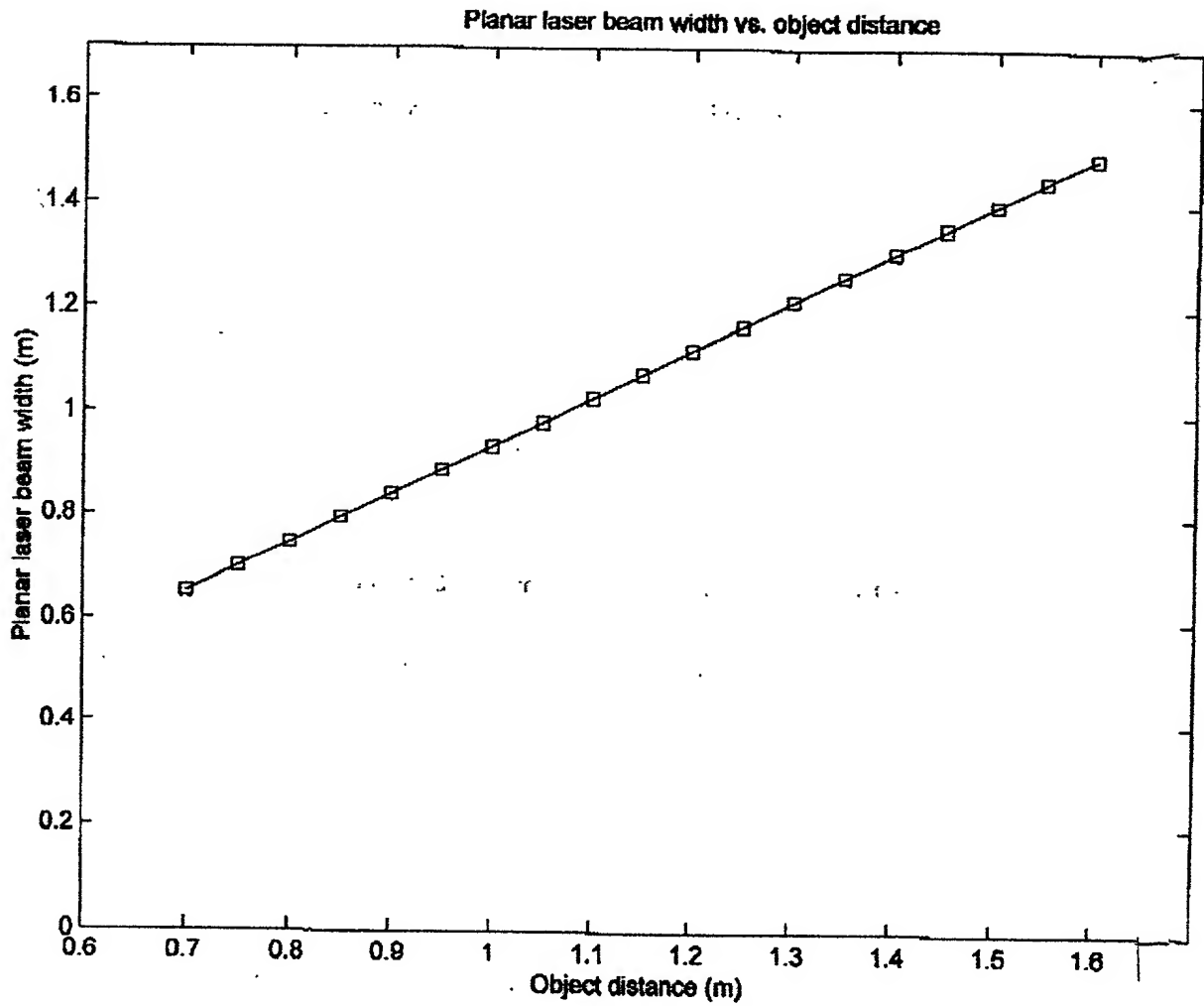


FIG. 1M3

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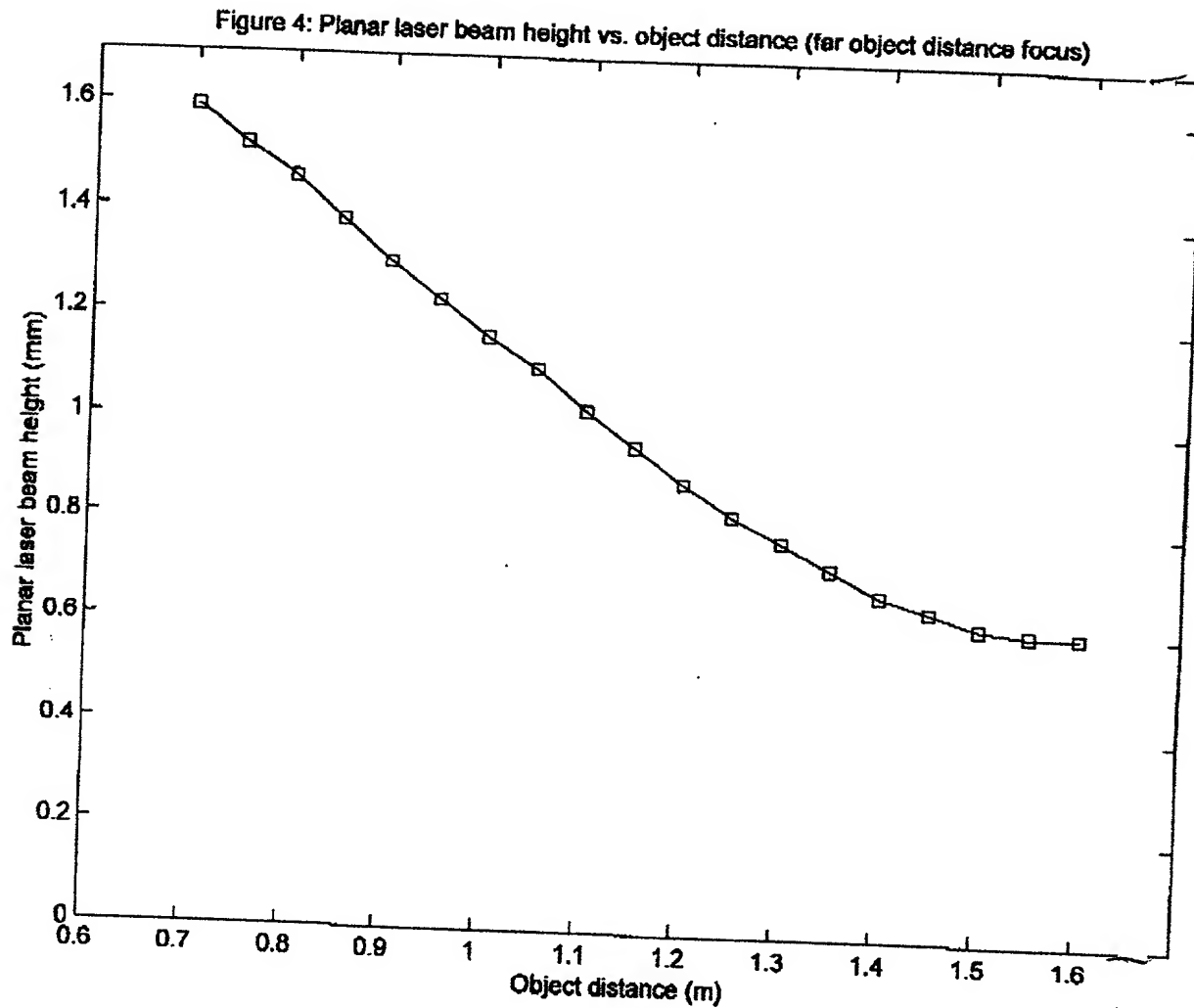


FIG 1M4

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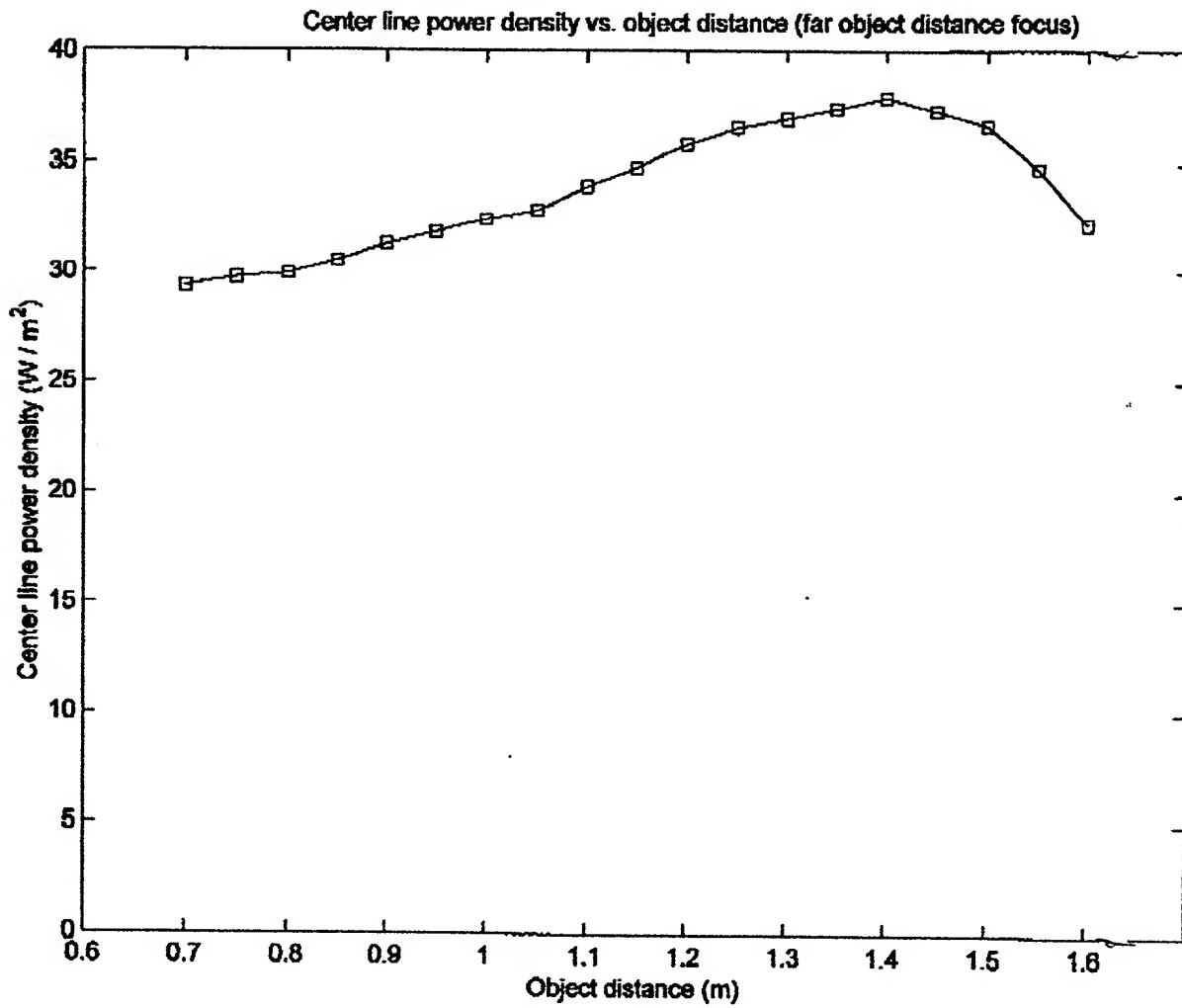


FIG. 1N

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Figure 6: Pixel power densities vs. object distance

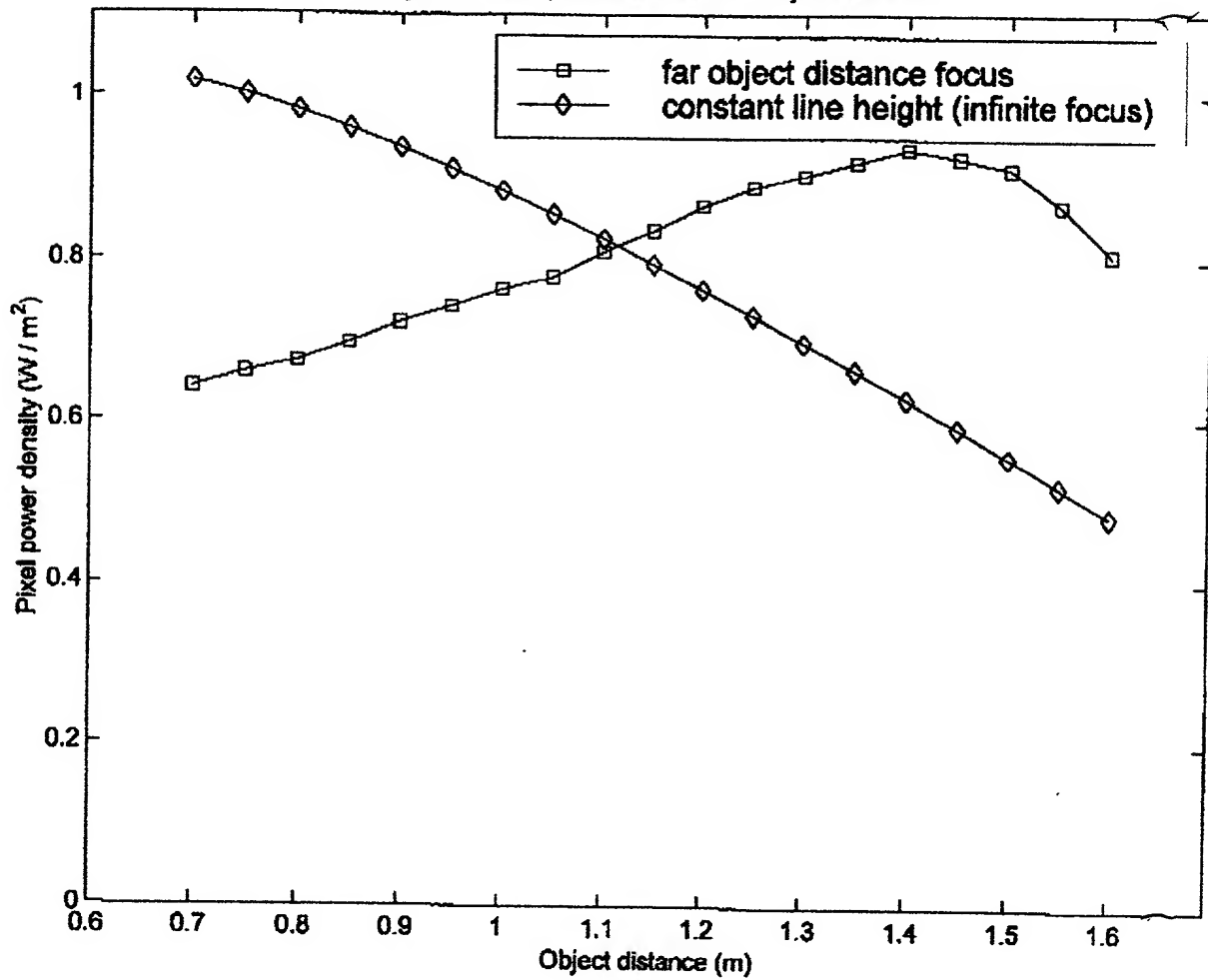


FIG. 10

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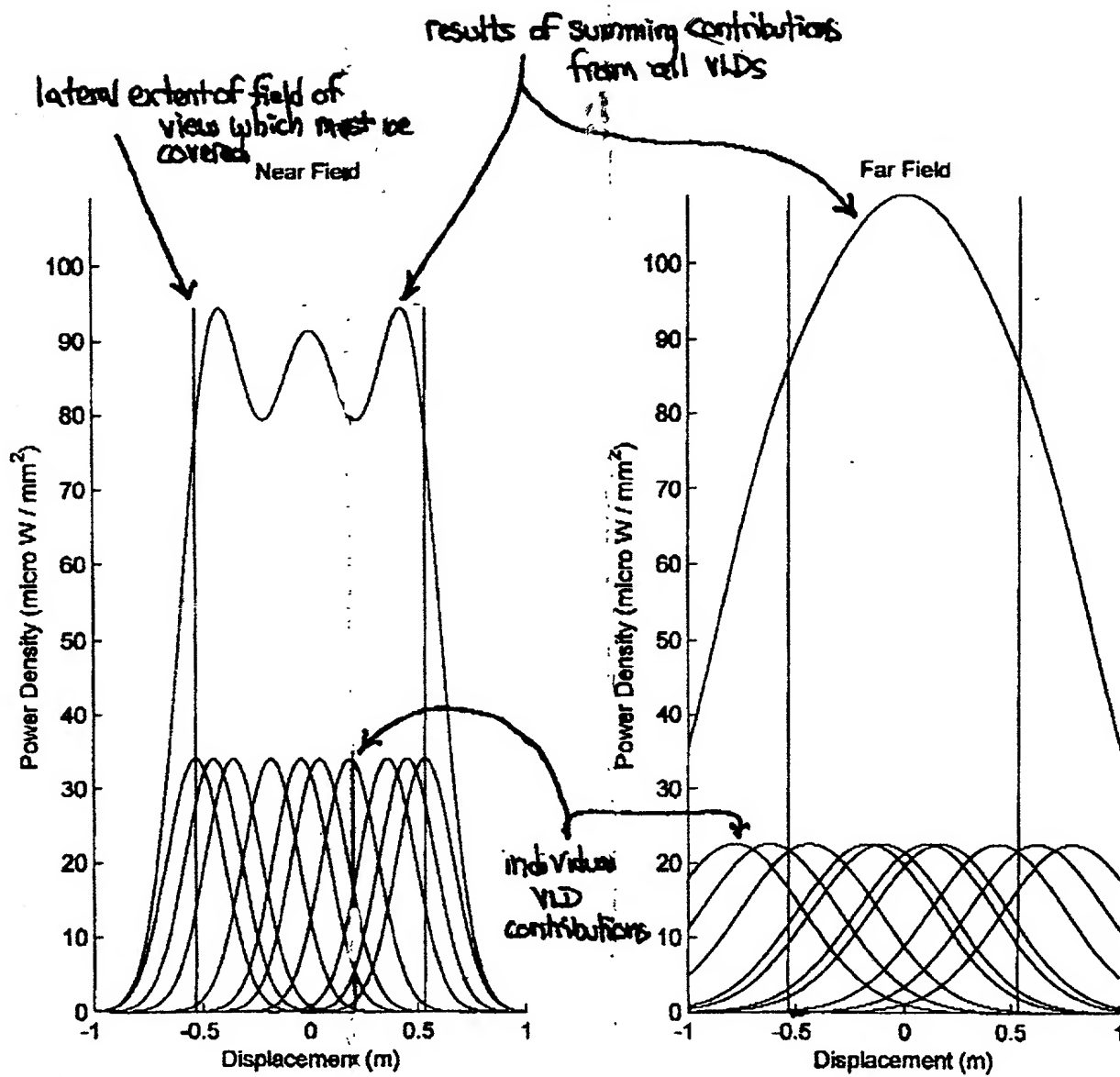


FIG 1P1

FIG 1P2

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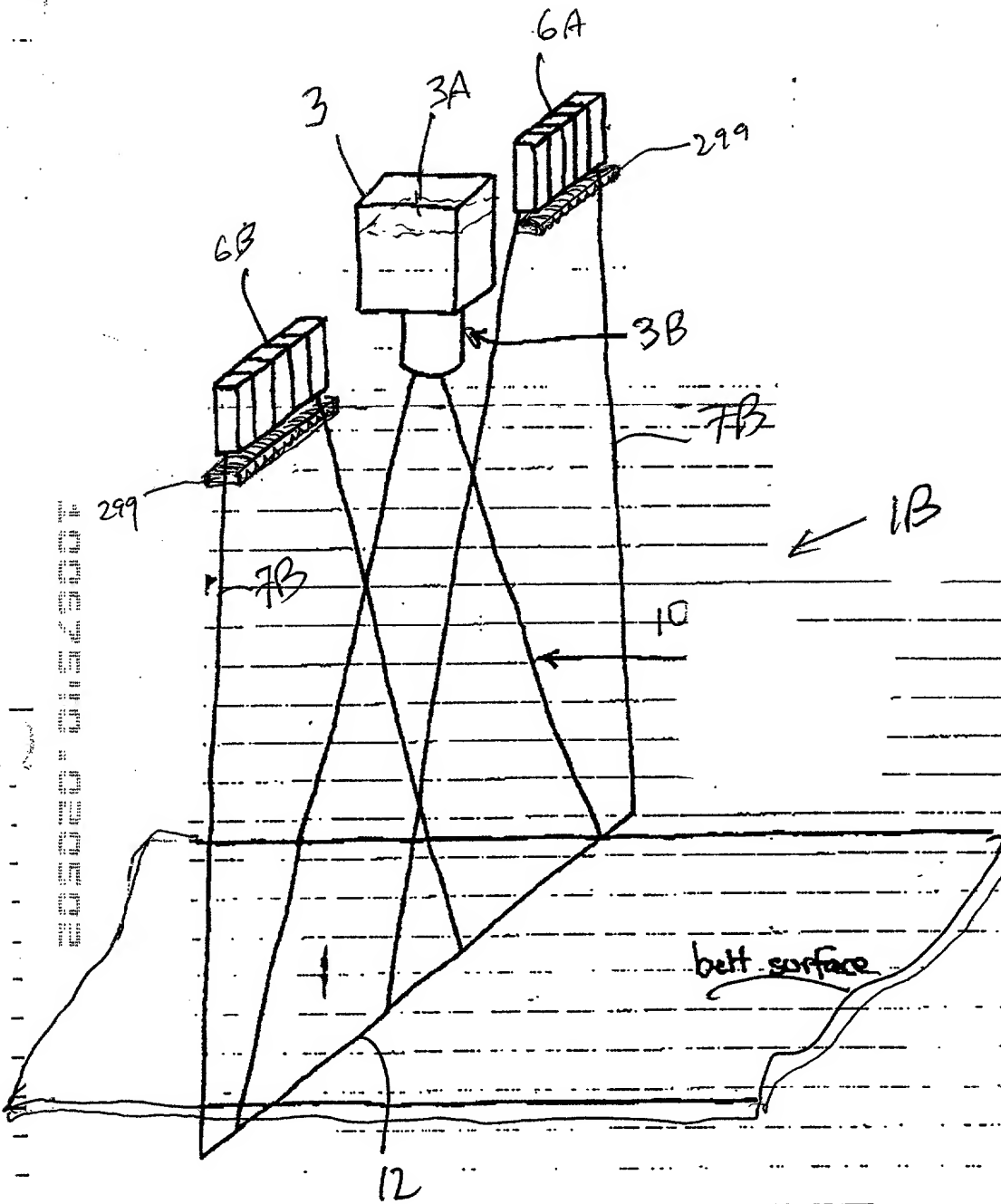


FIG. 101

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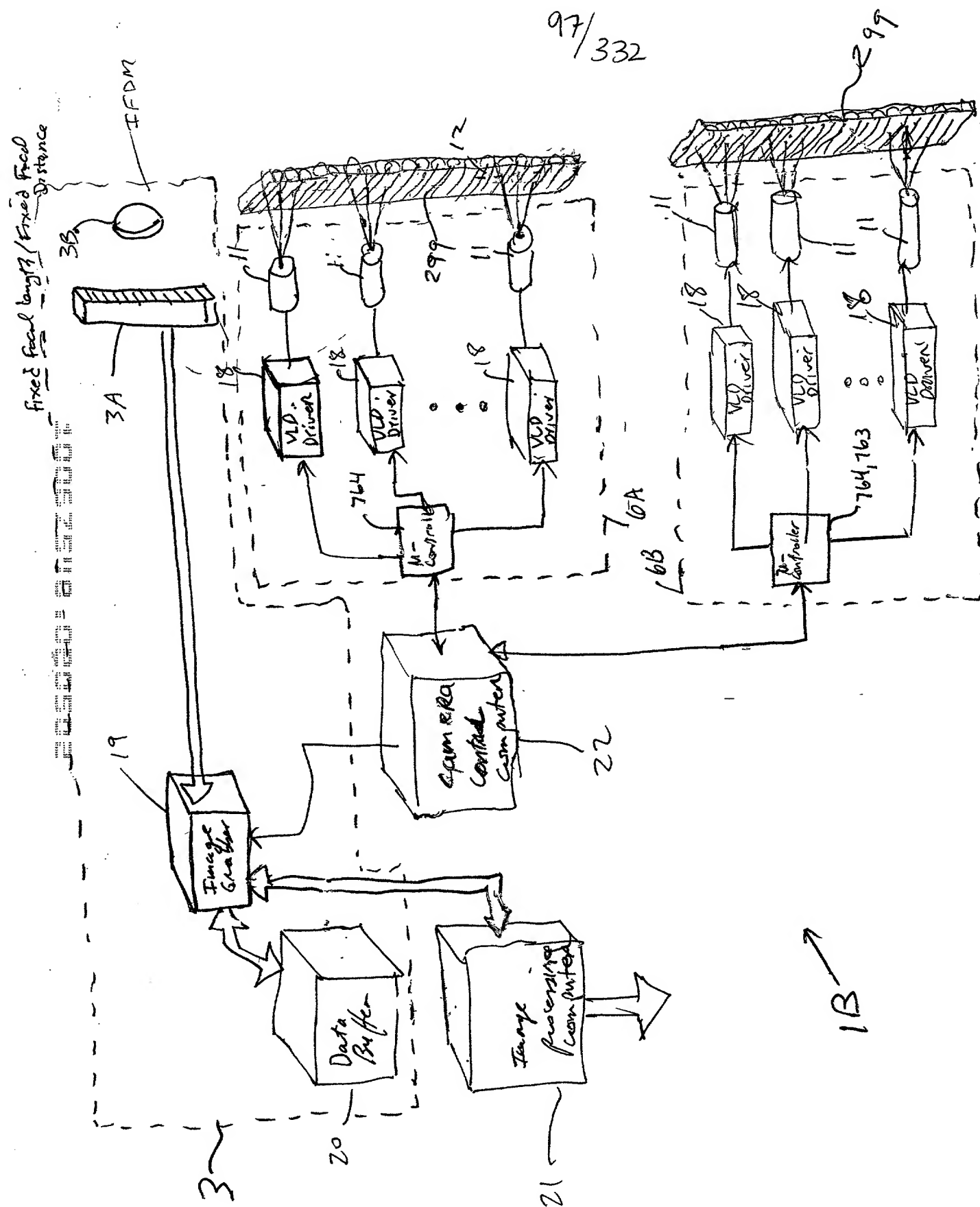
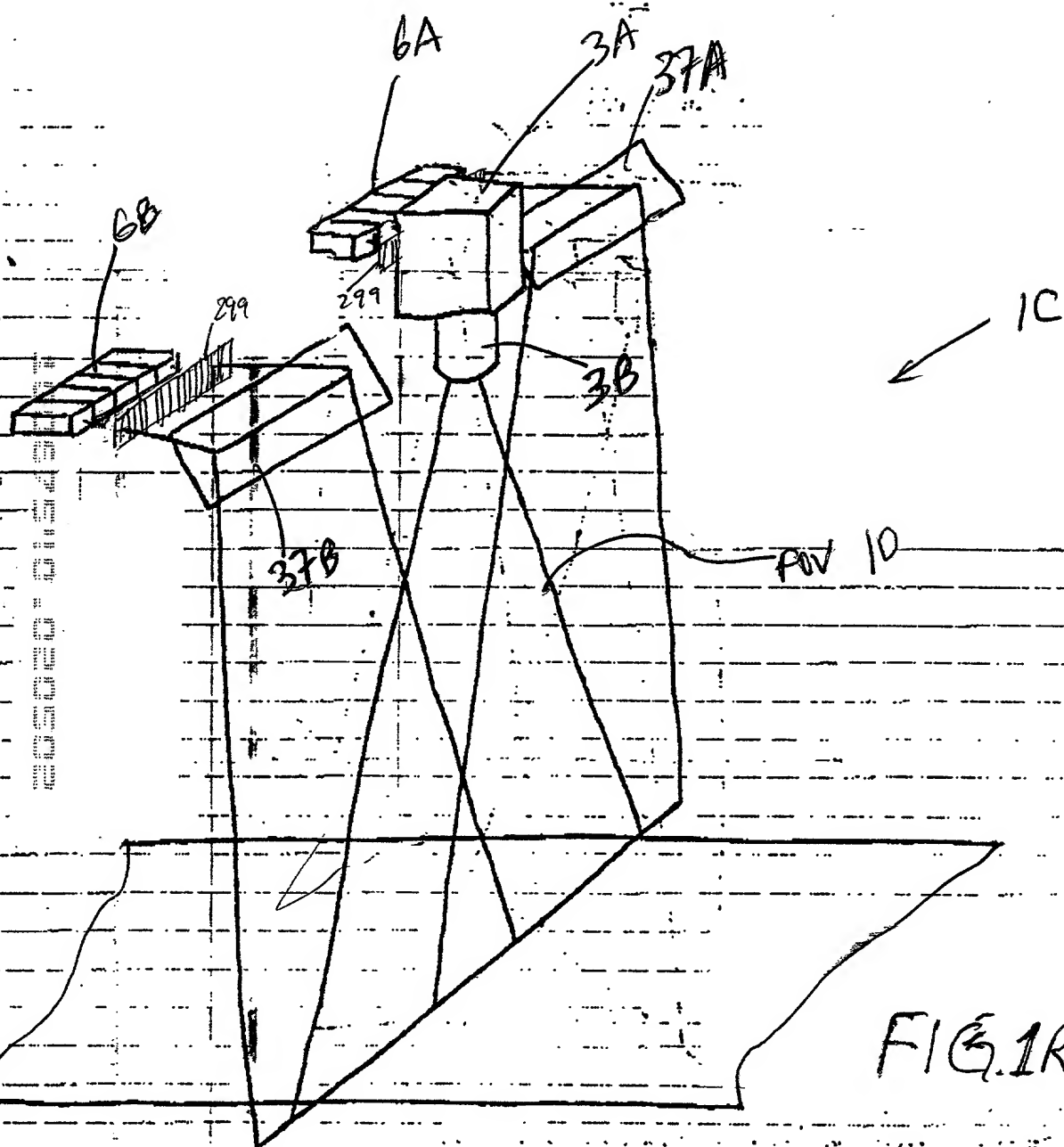


FIG. 102

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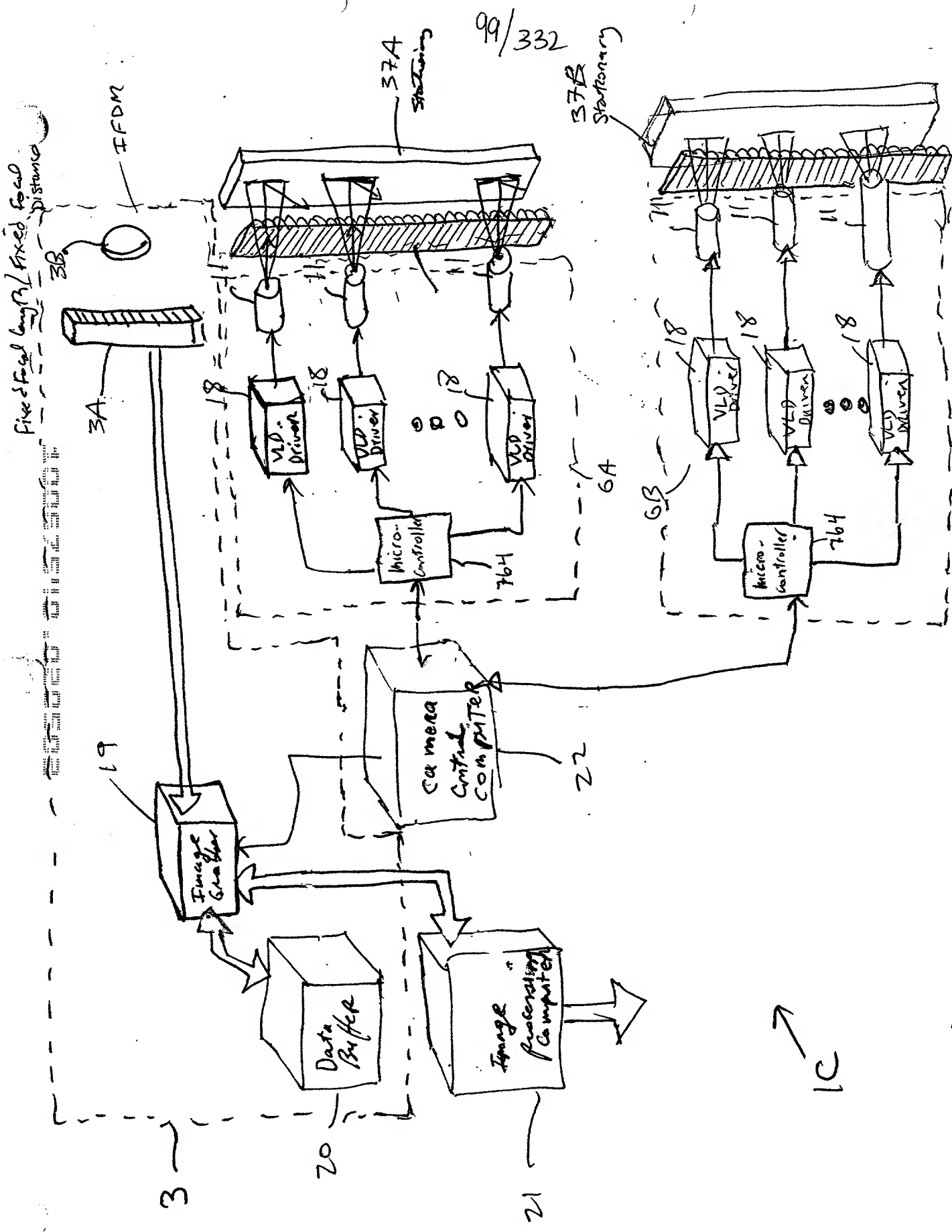


FIG. 1R2

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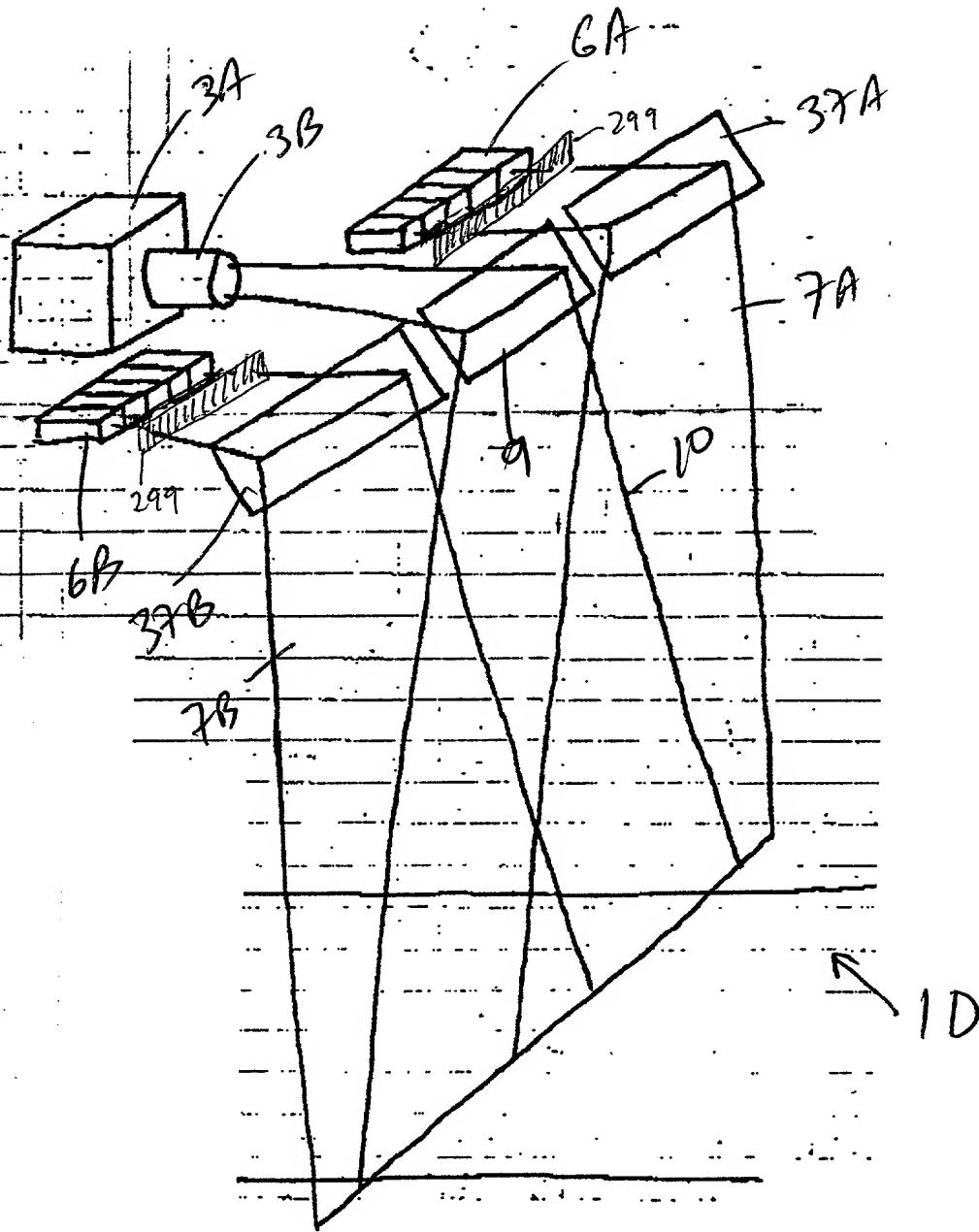


FIG. 1S1

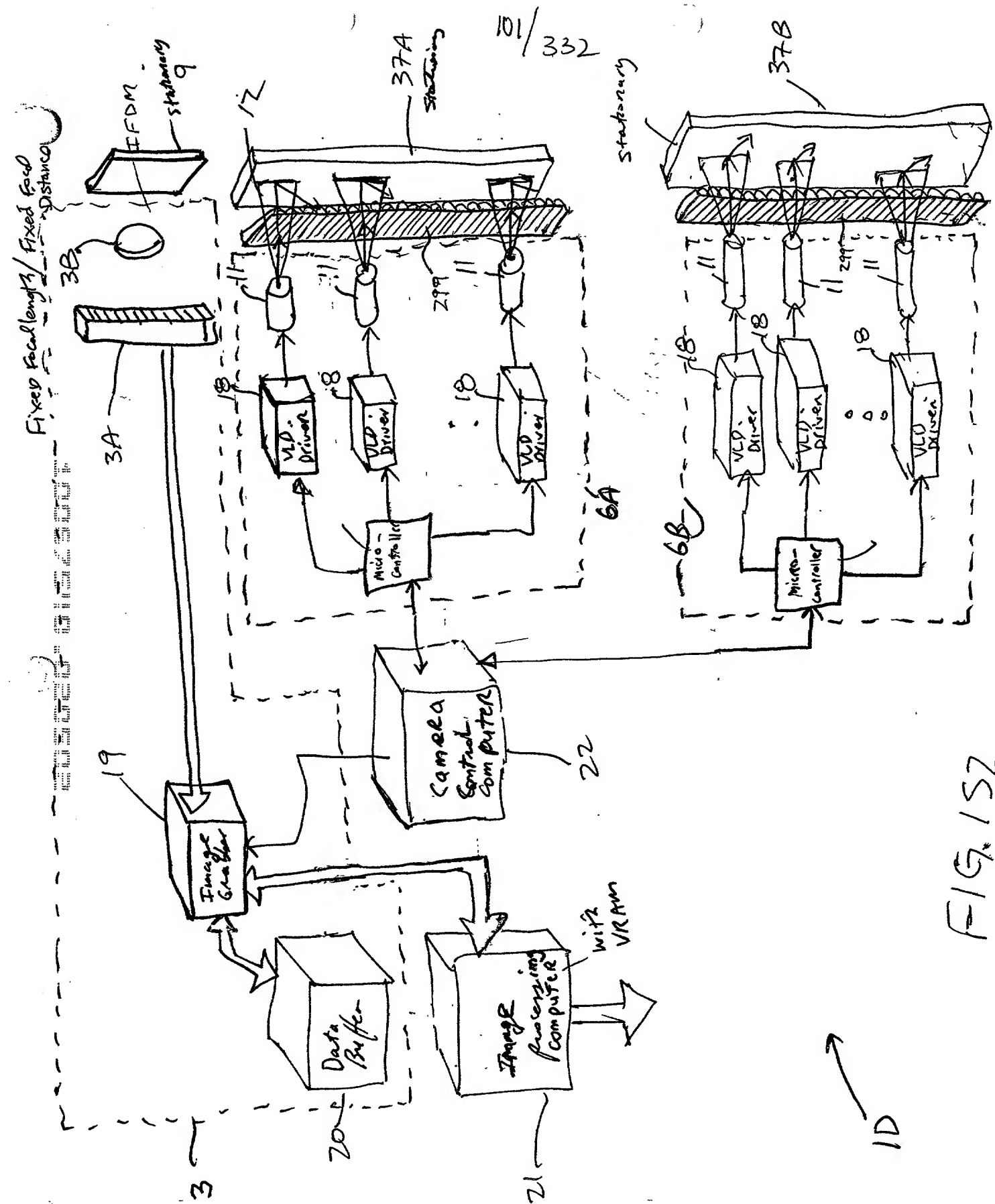


FIG. 152

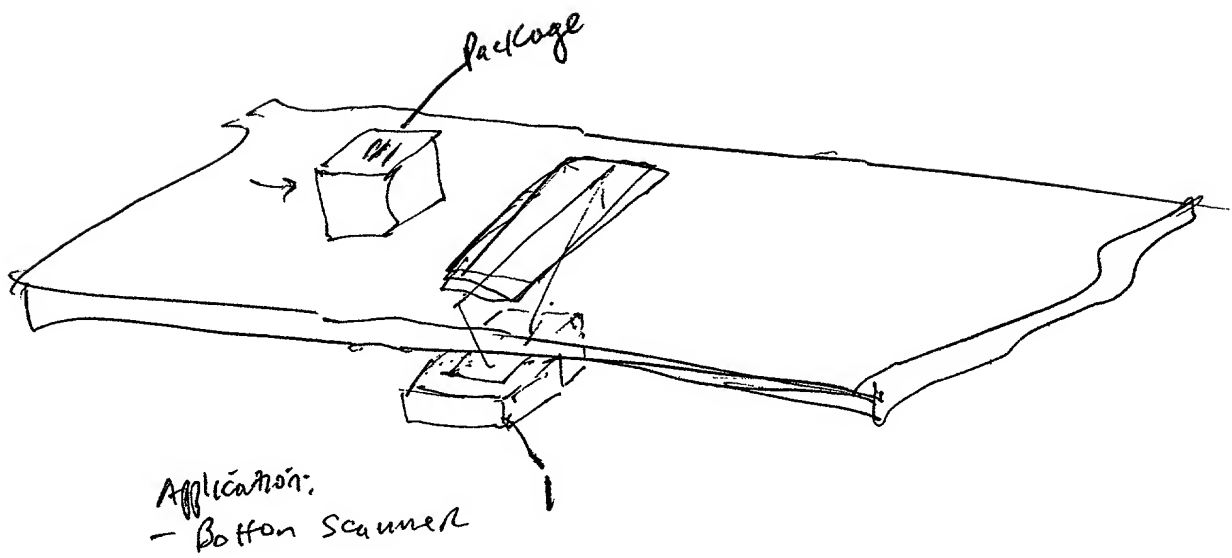
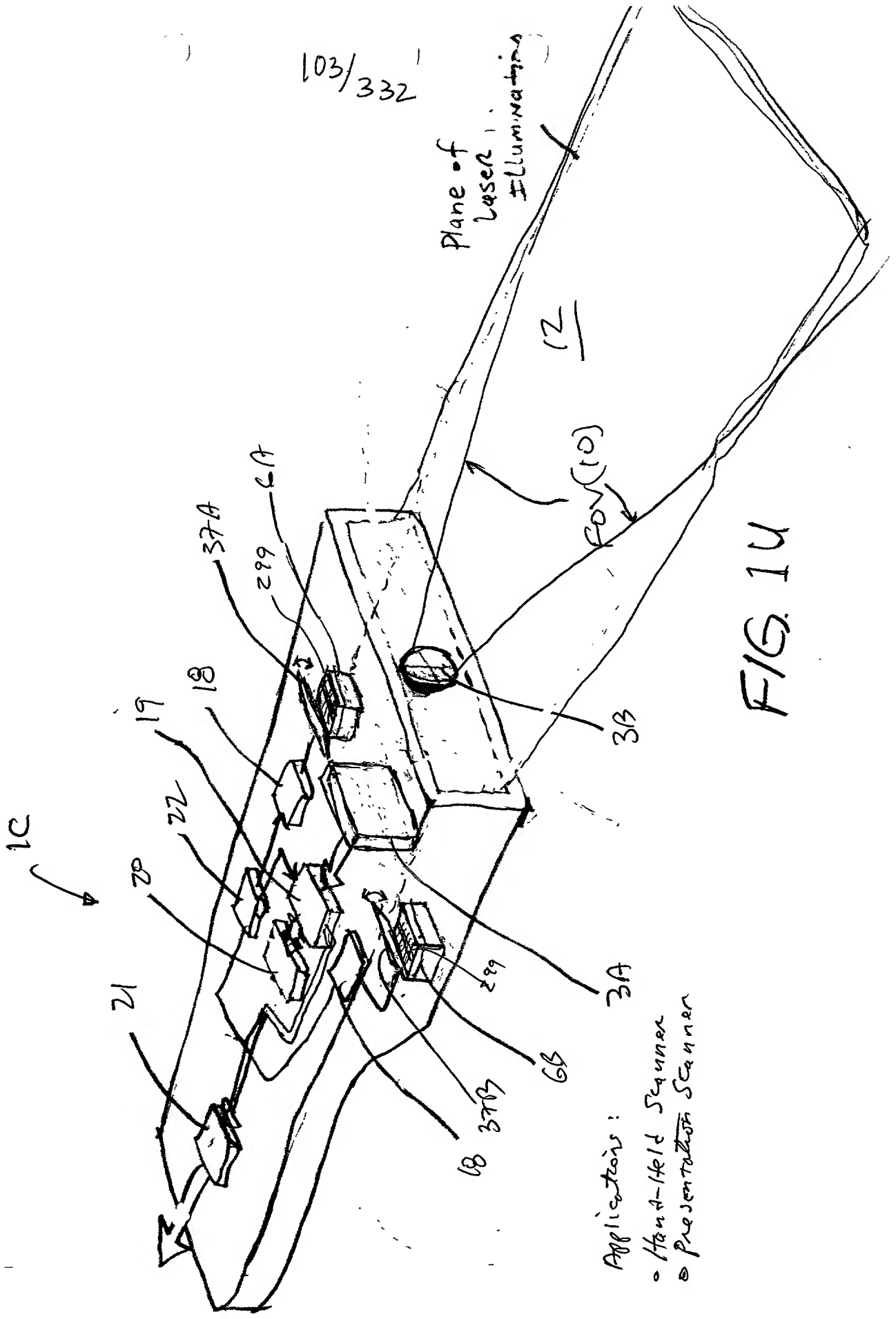


FIG 1T

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Plane of
Laser
Illumination

(2)

fov(10)

FIG. 1U

Applications:

- Hand-Held Scanner
- Presentation Scanner

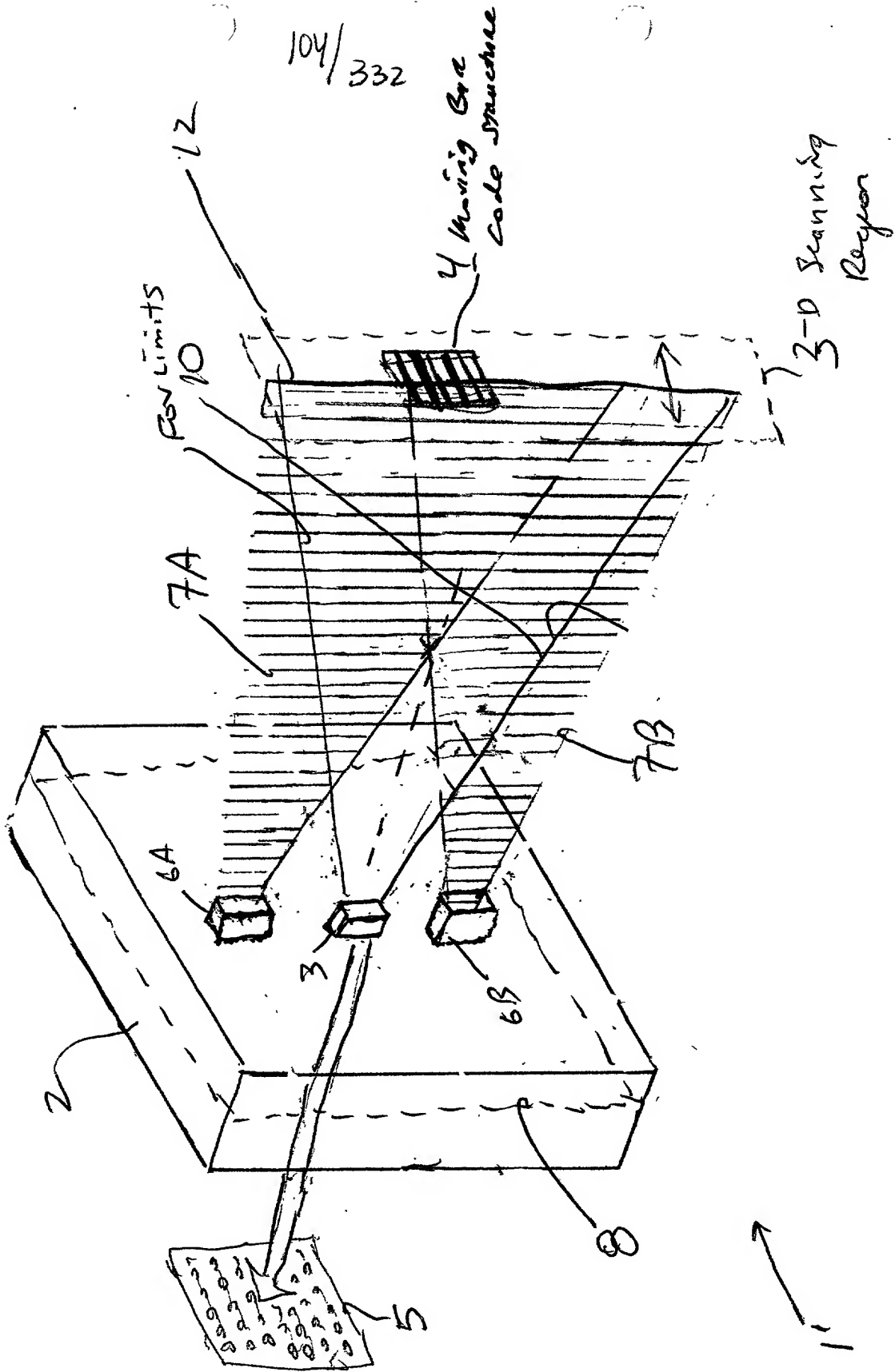


FIG. IVI

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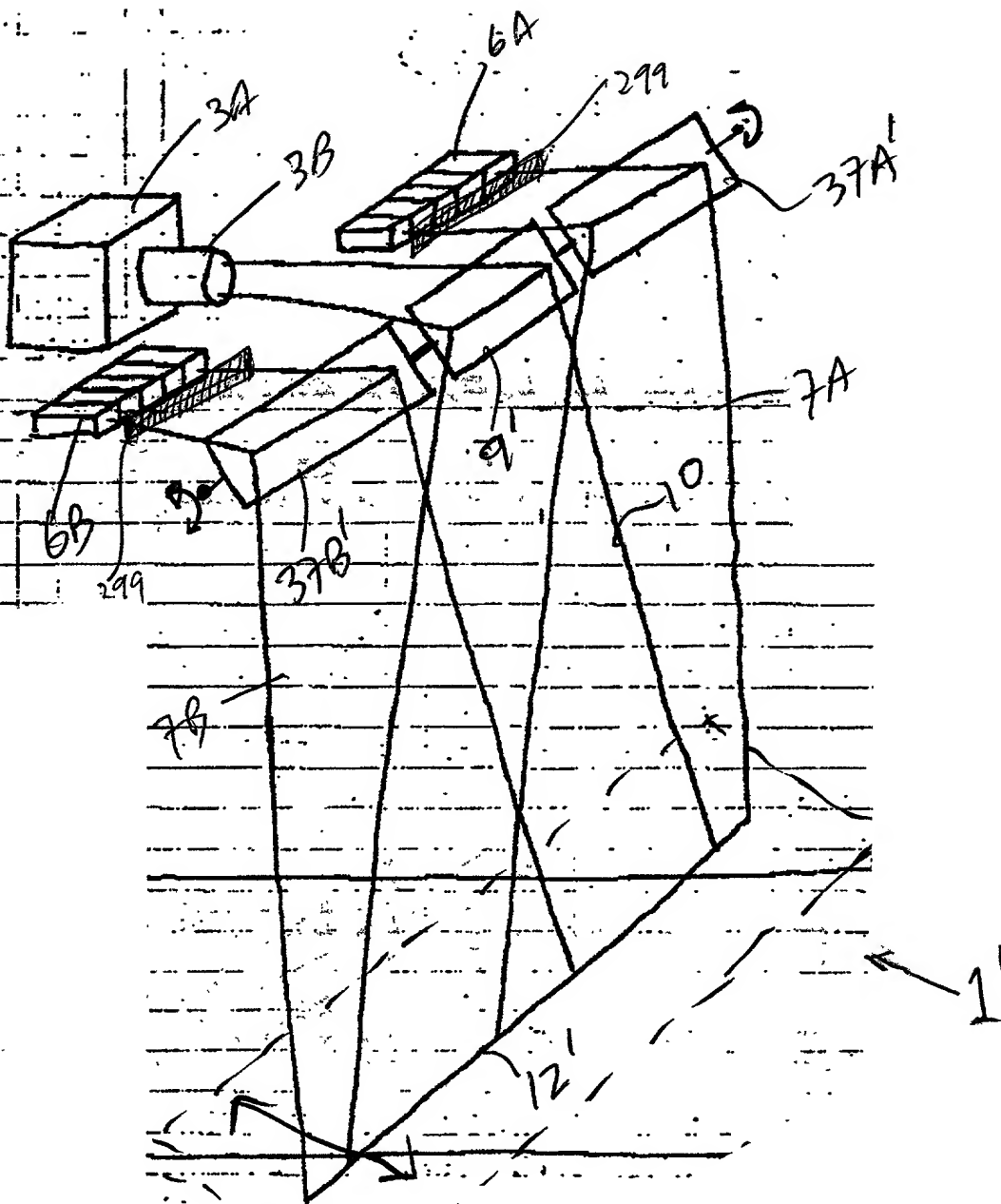
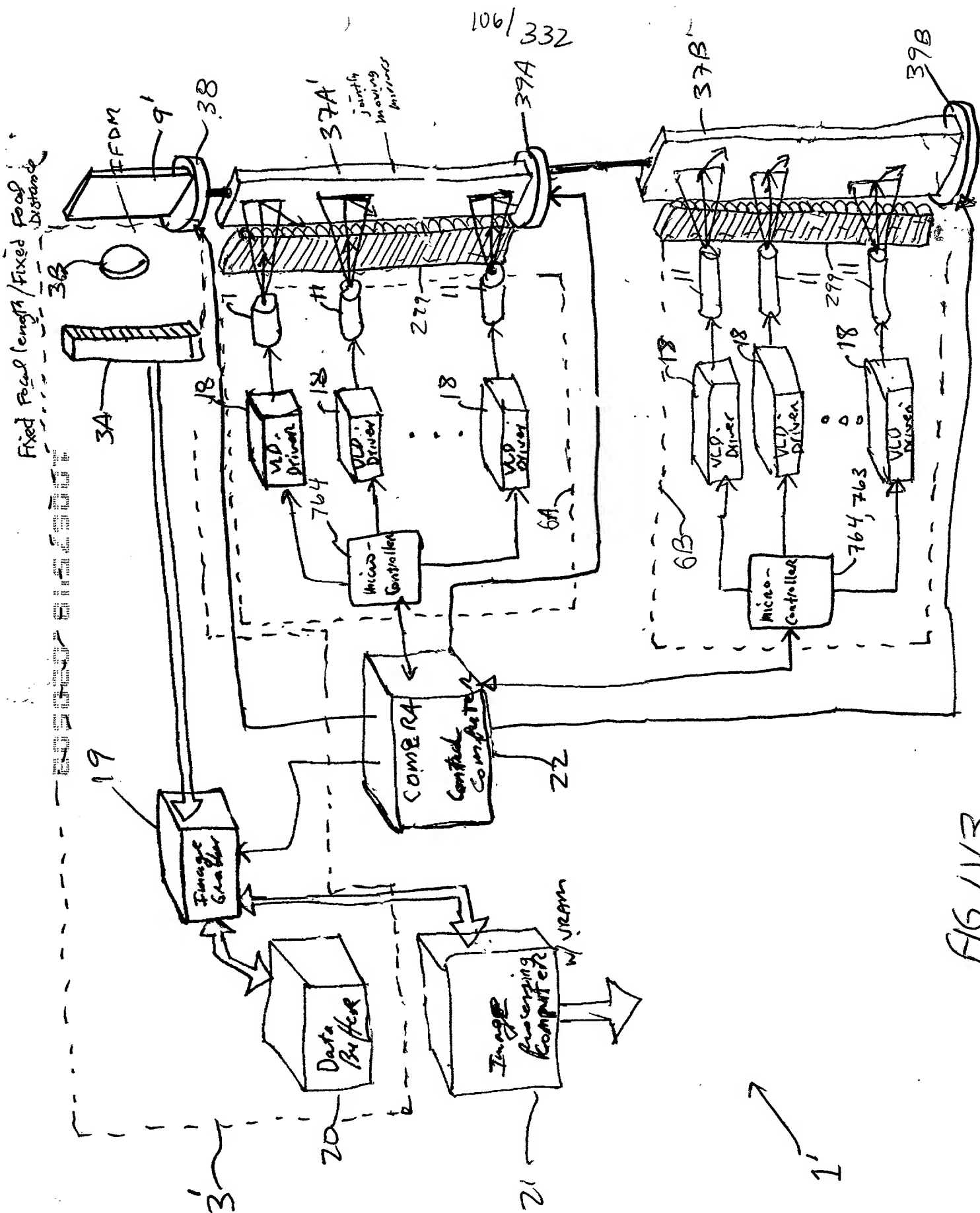


FIG. IV2

3-D
region
of
space

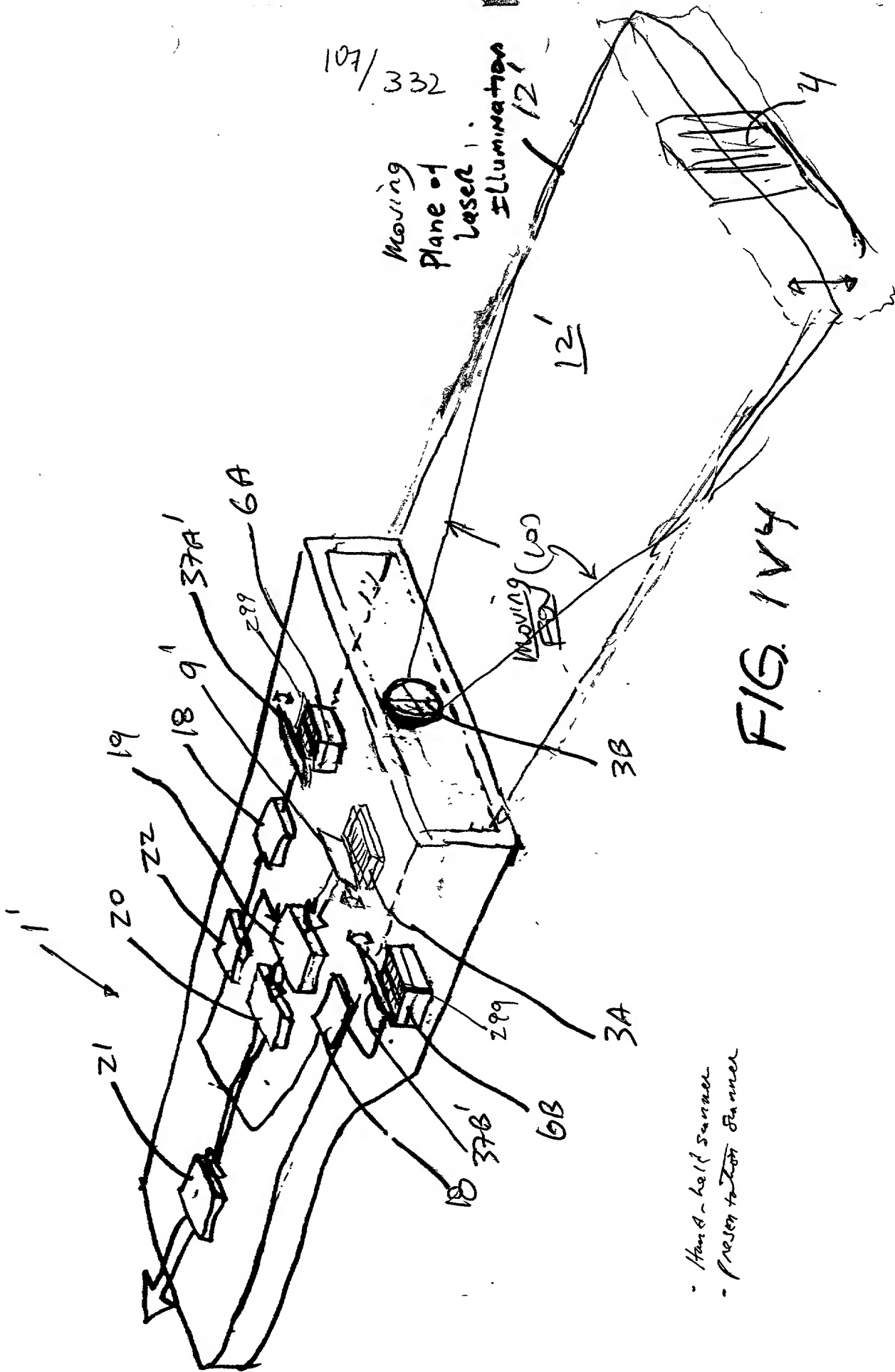


Moving
Plane of
Laser
Flu

Moving
Plane of
Laser
Flu

FIG. 14

- Hand-held scanner
- Present to two scanner



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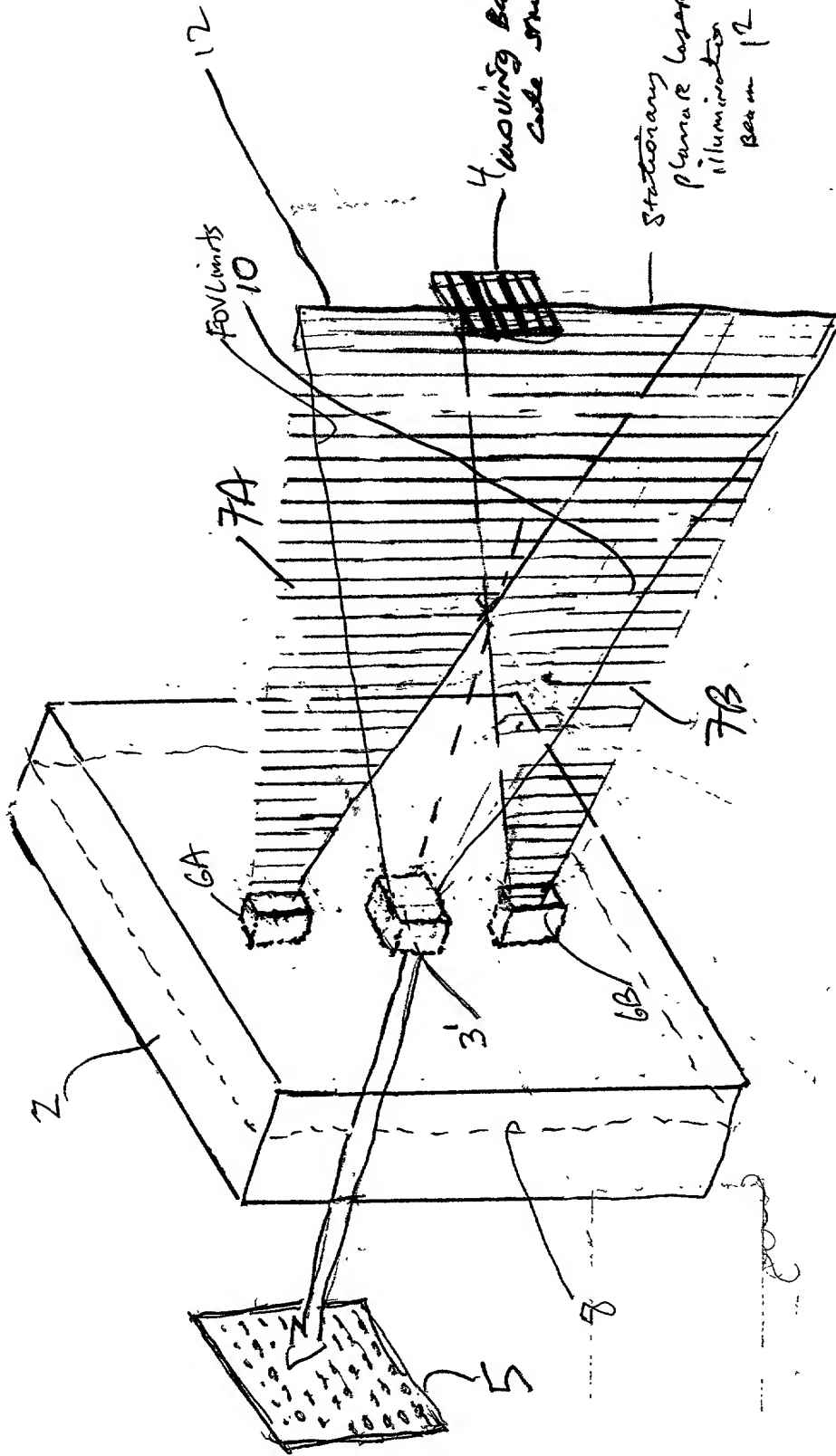


FIG. 2A

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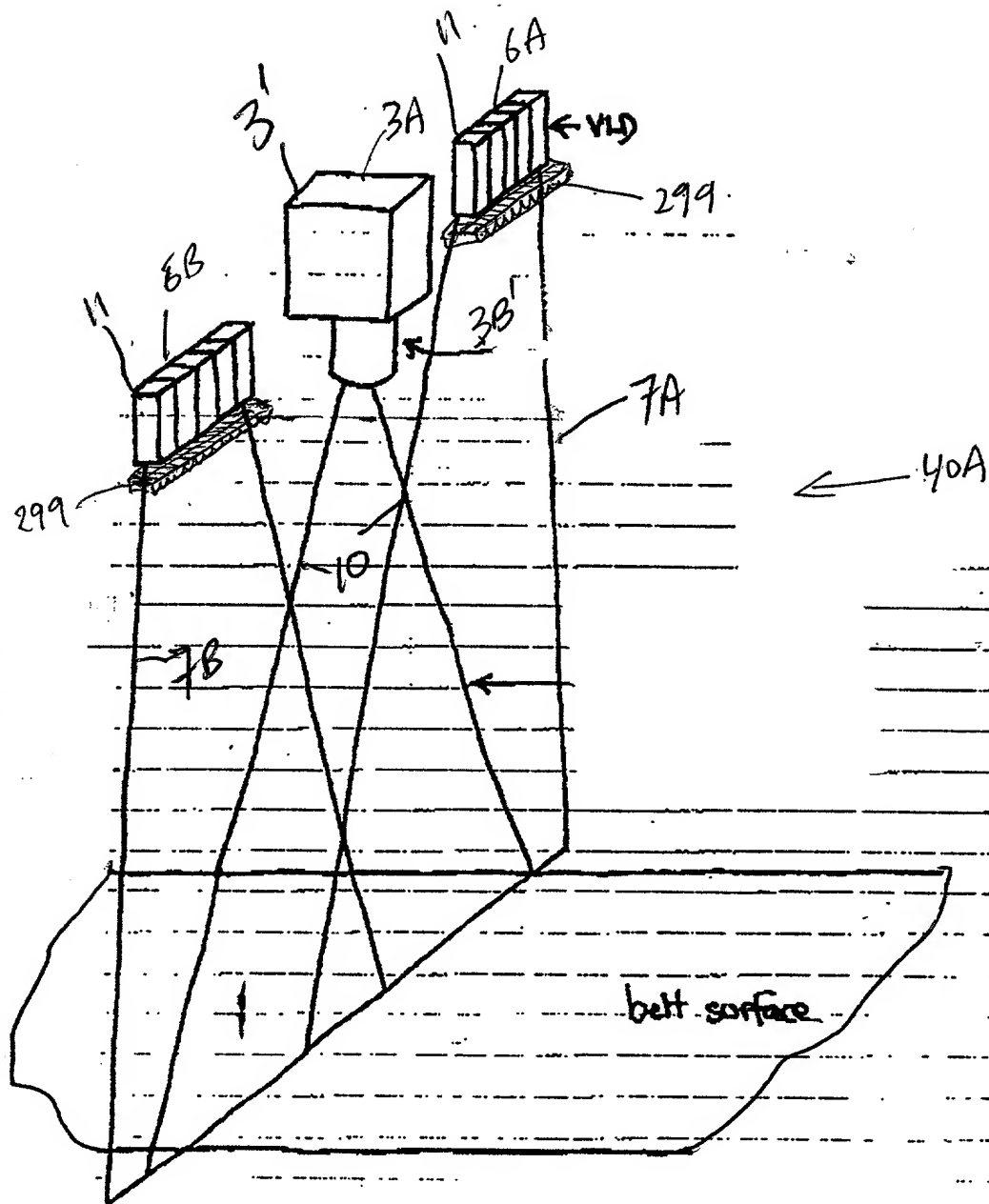
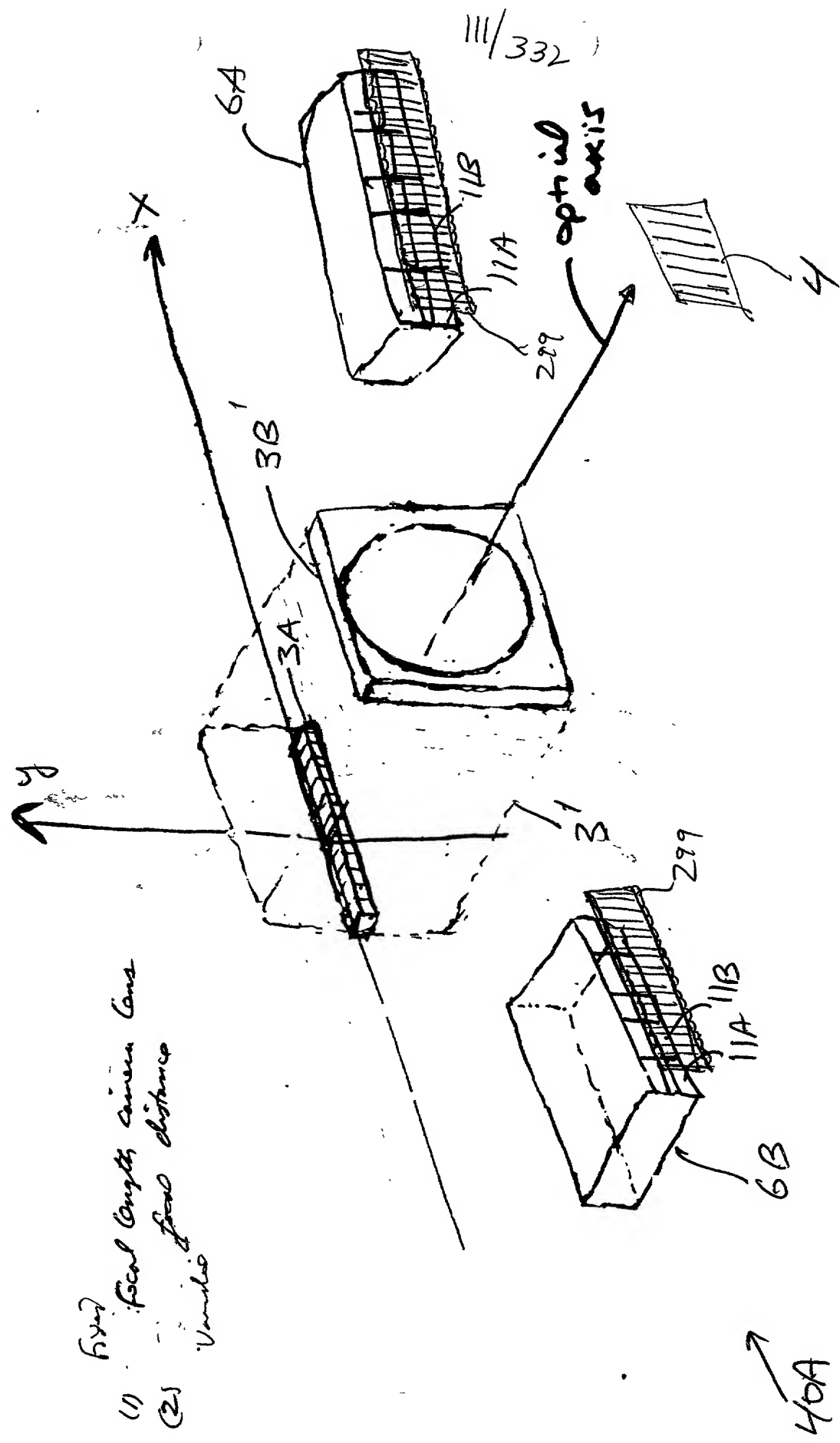


FIG. 2 B1

FIG. 2B2



- Fixed
- (1) focal length camera lens
 - (2) focus distance
- Variable

FIG. 2B2

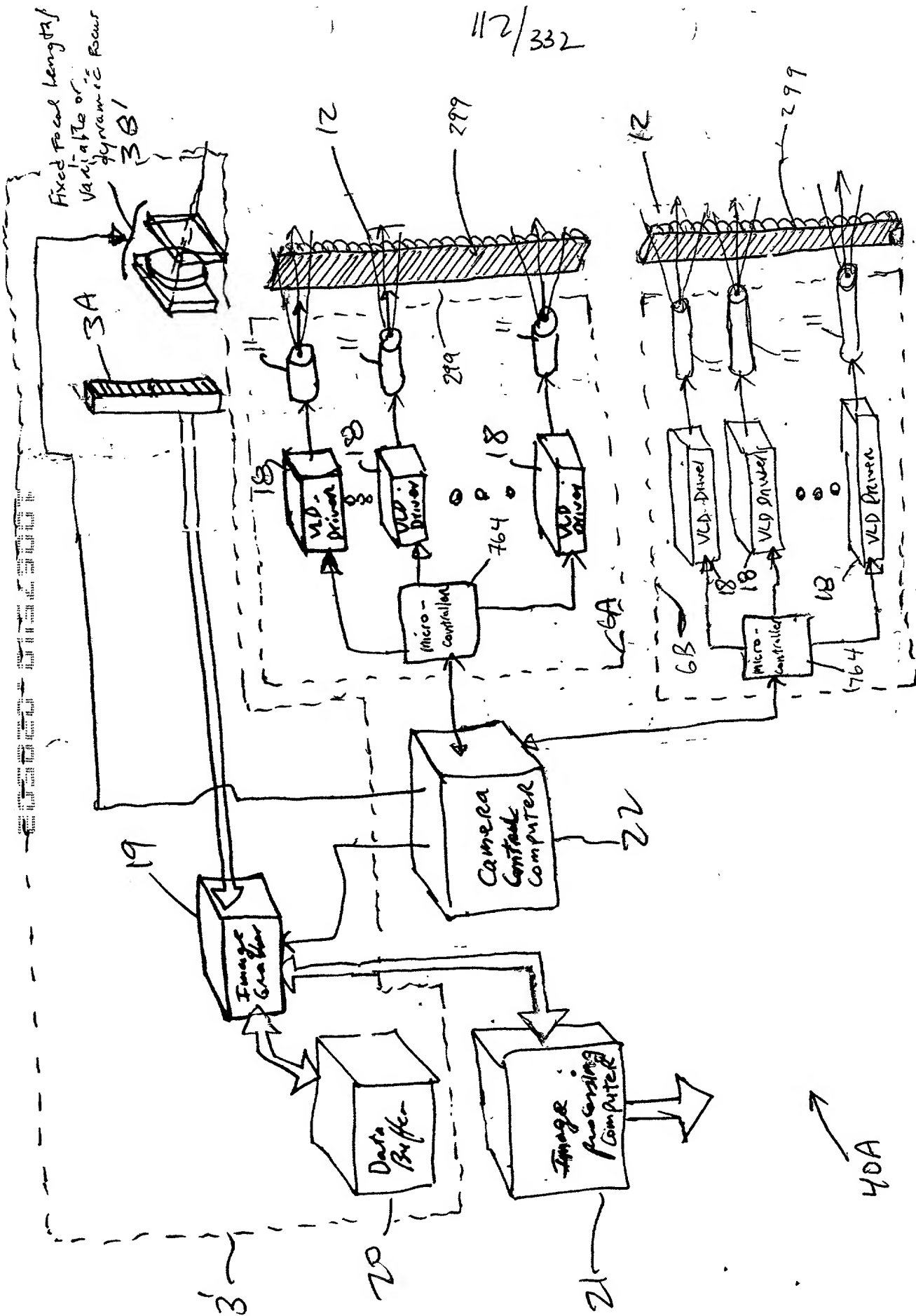
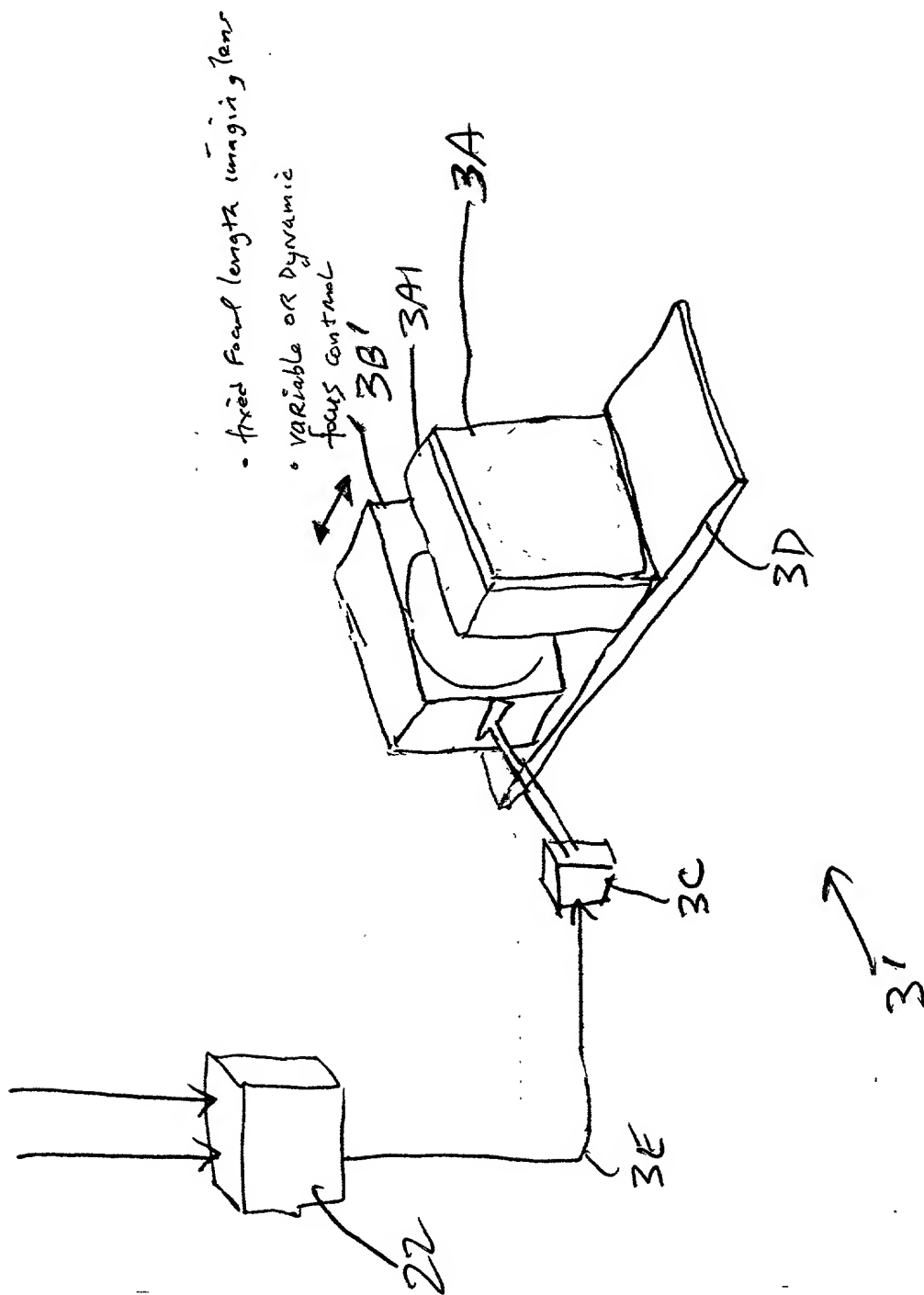


FIG. 2C1



• fixed focal length imaging lens
• variable or dynamic focus control

FIG. 2C2

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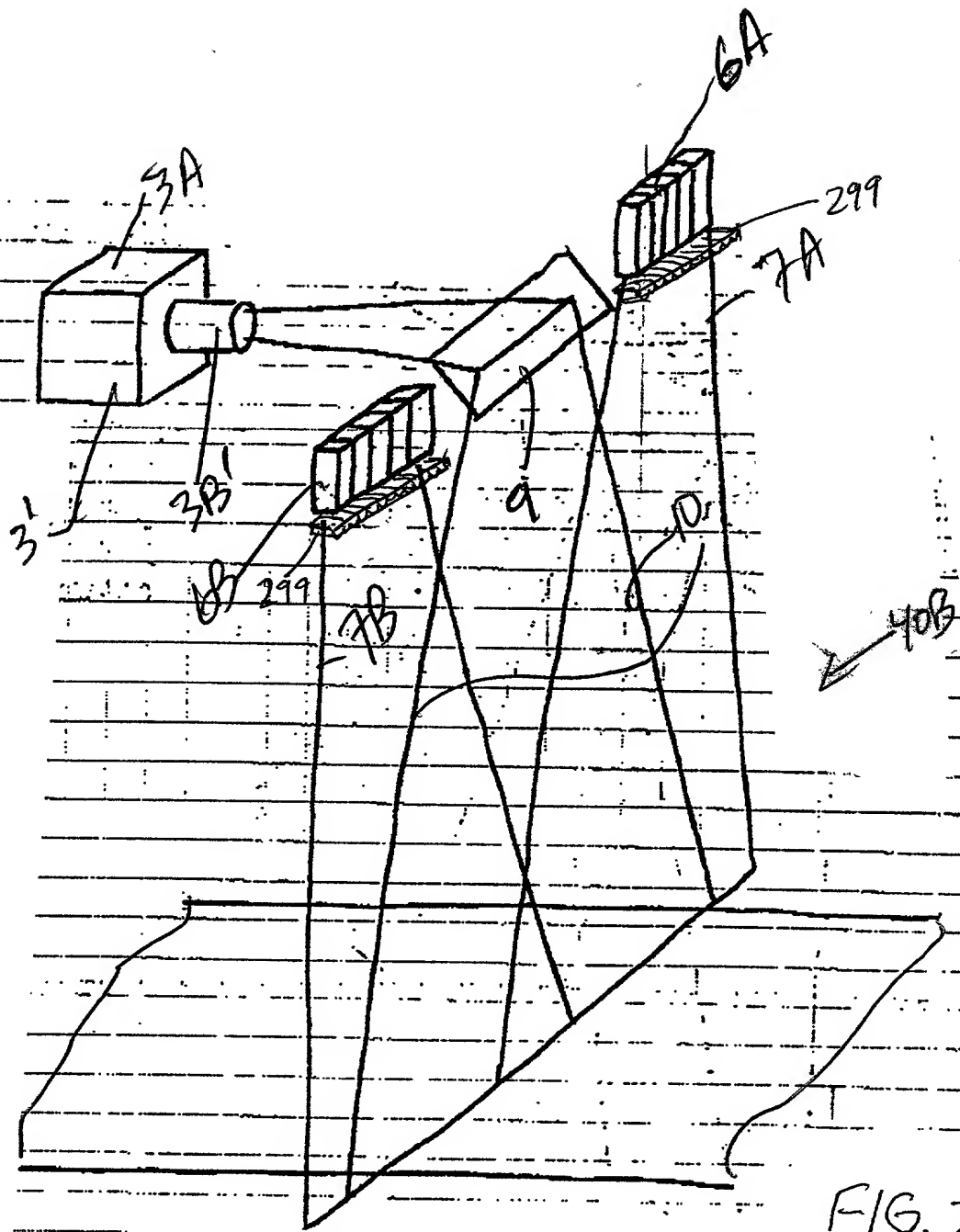


FIG. 2D1

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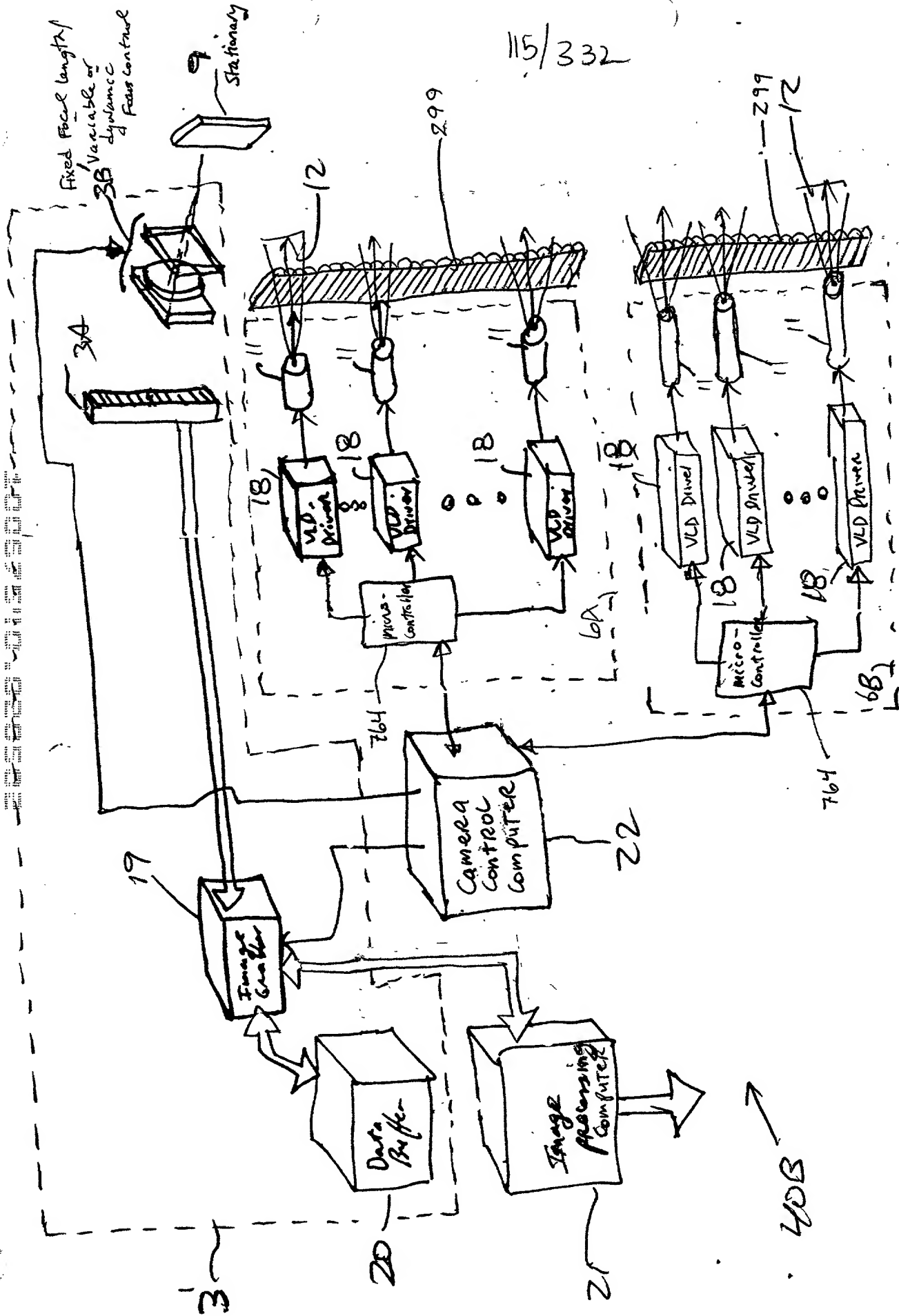


FIG. 2D2

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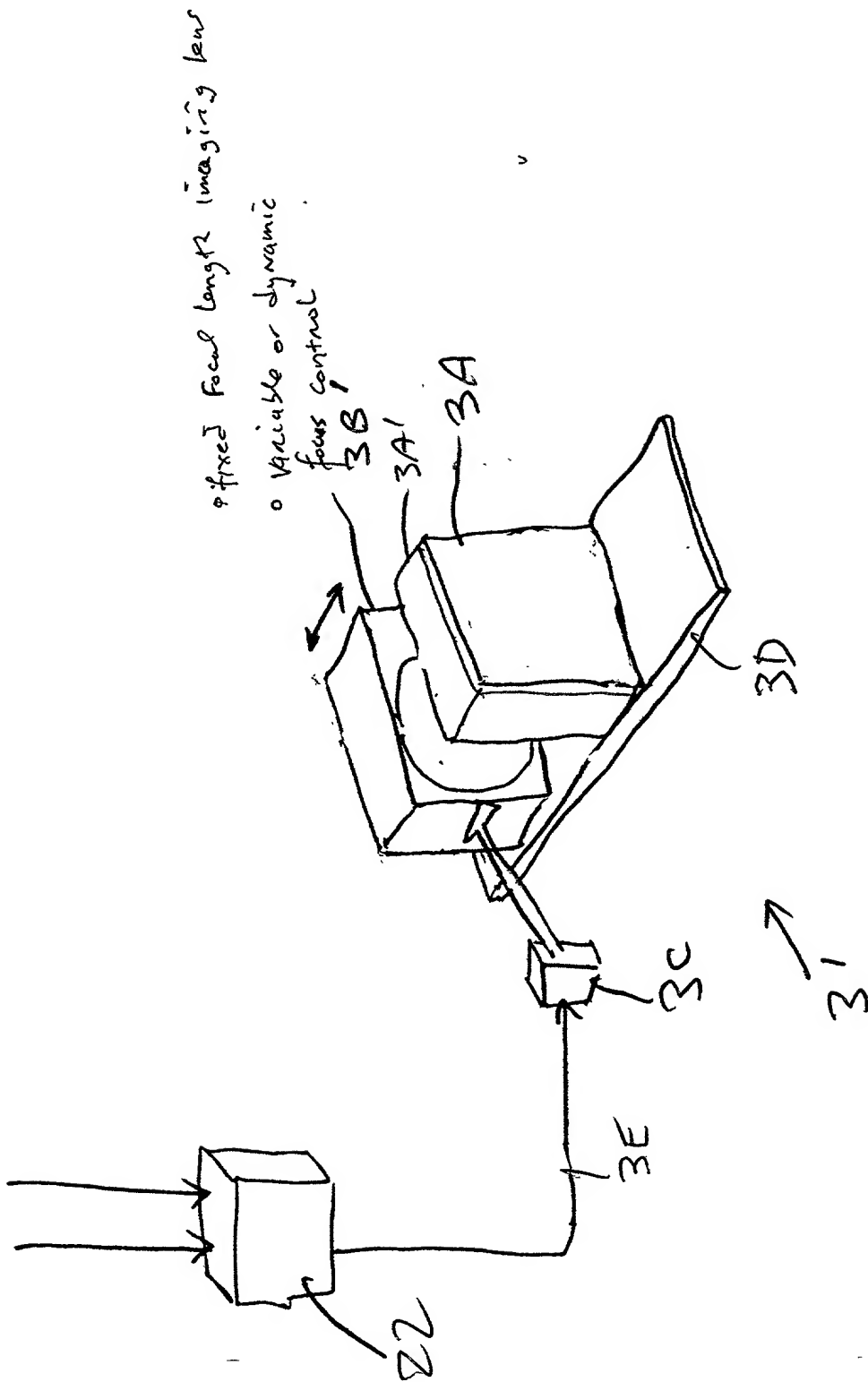


FIG. 2D3

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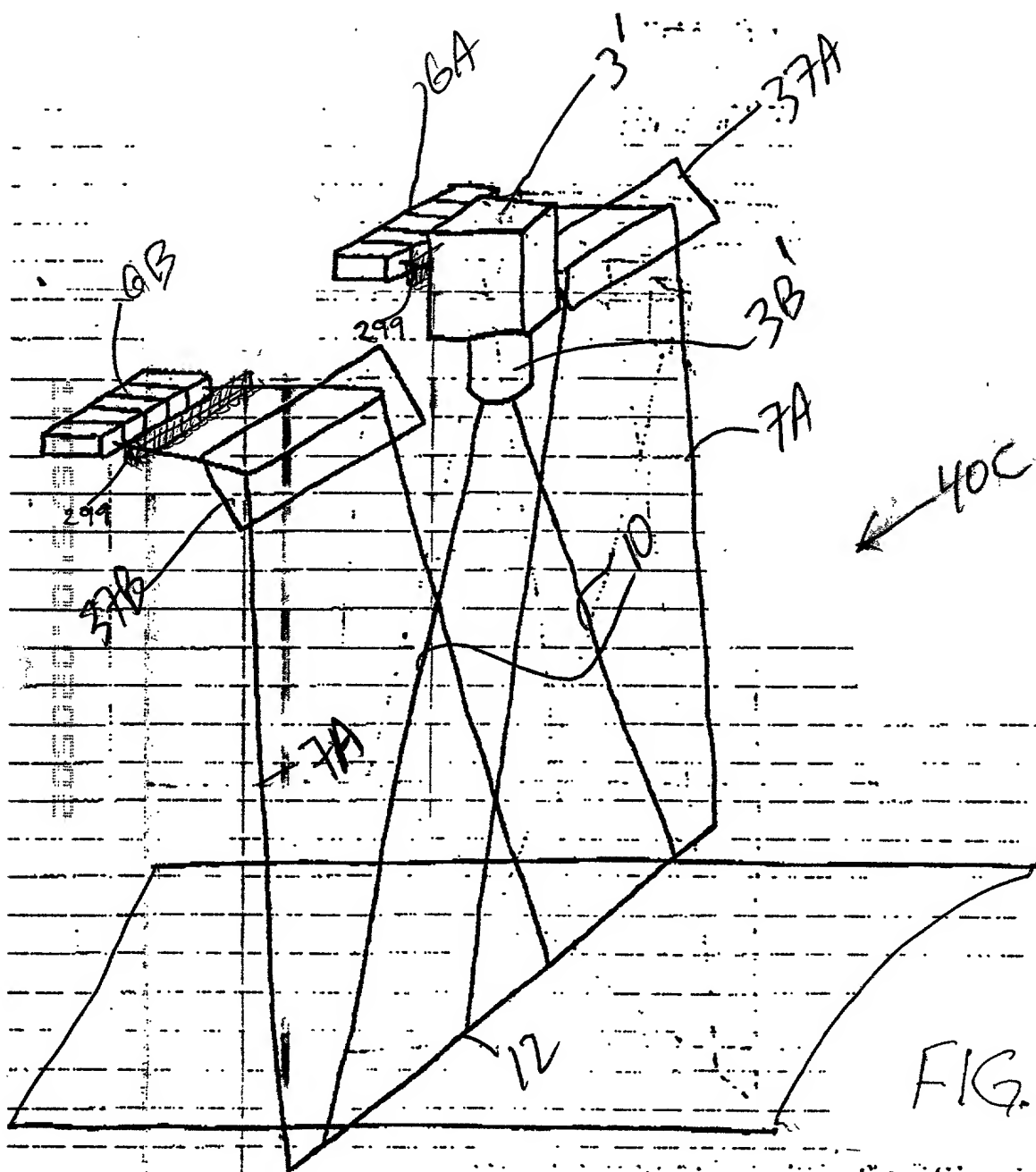


FIG. 2E1

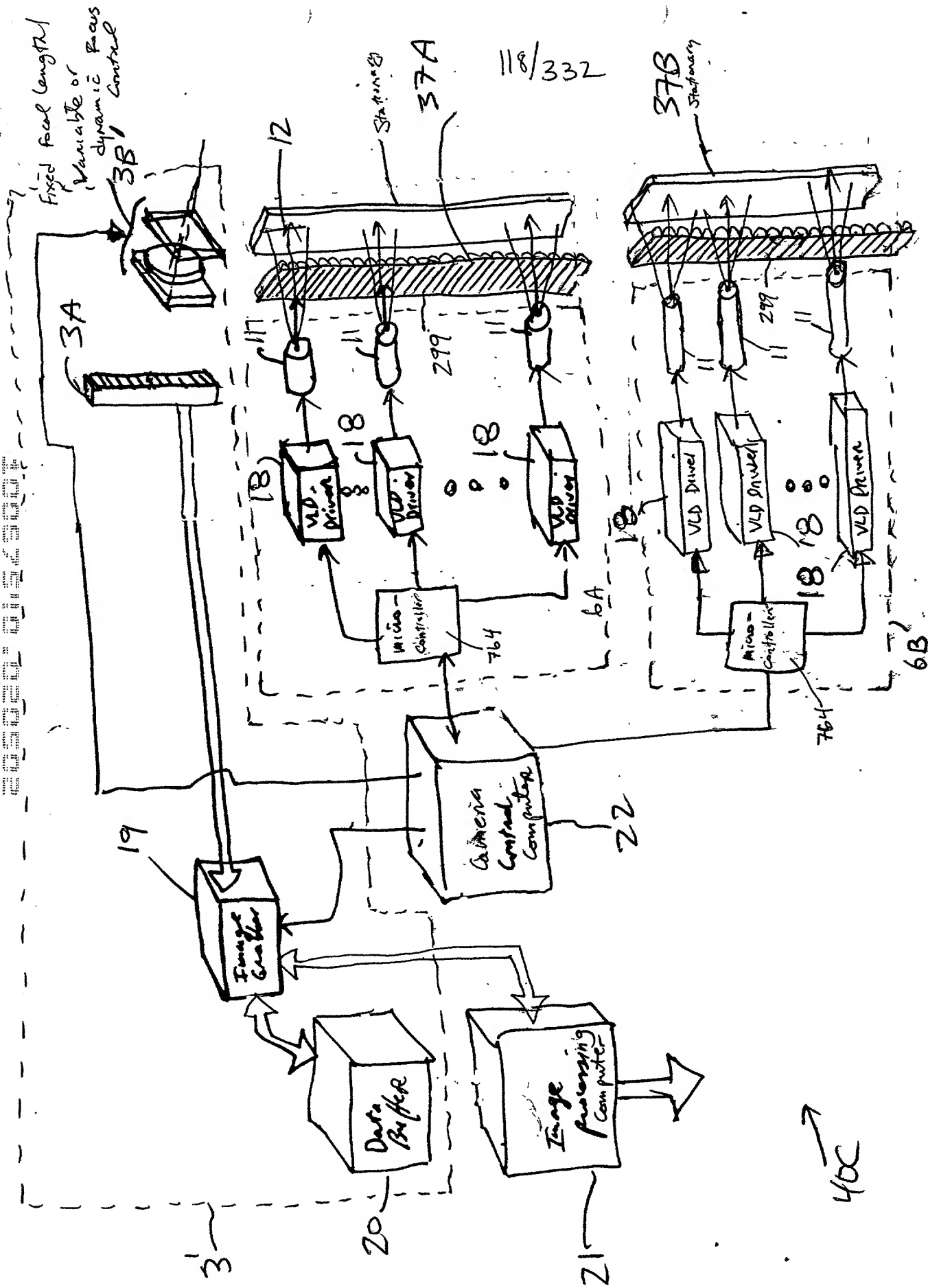


FIG. 2E2

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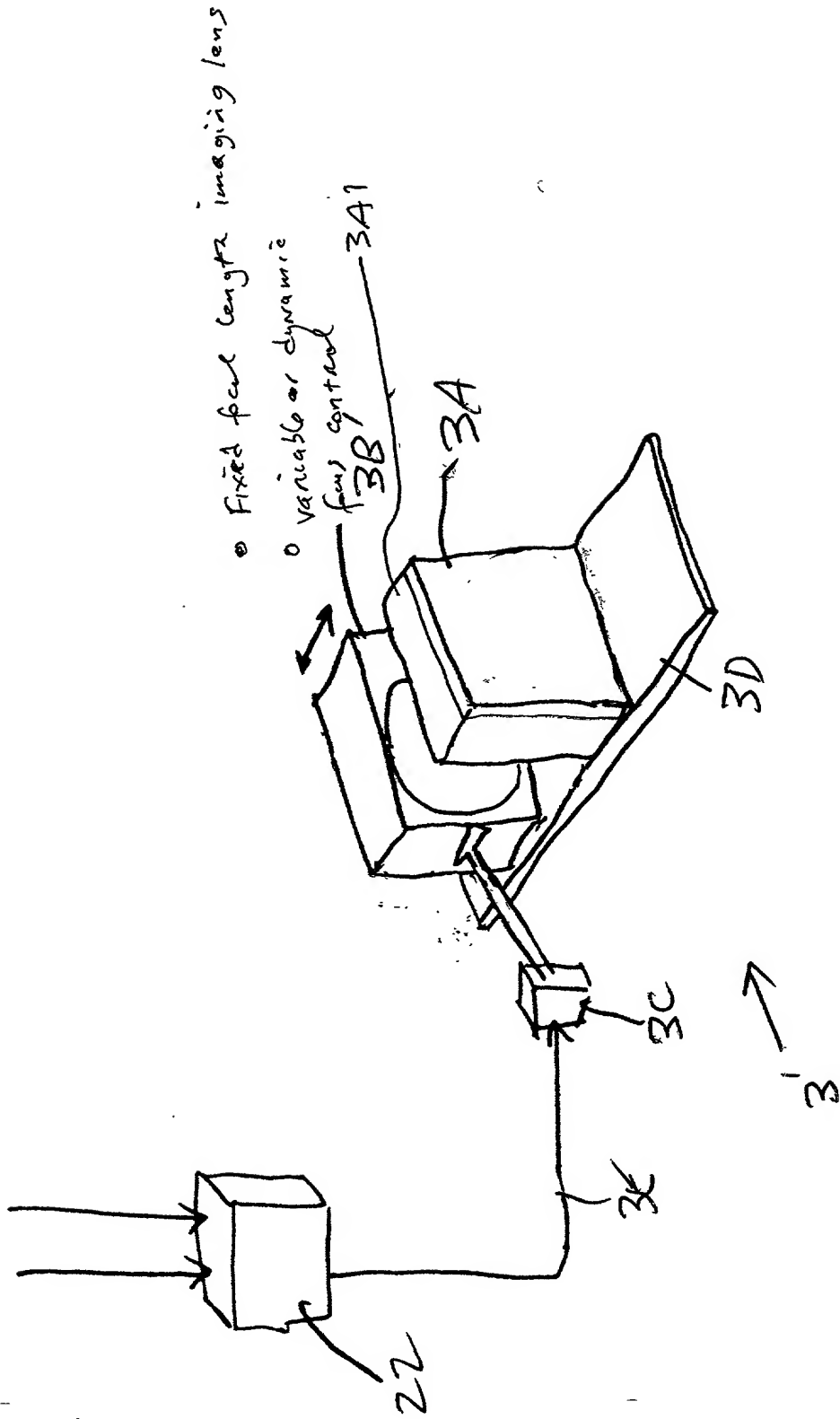


FIG. 2E3

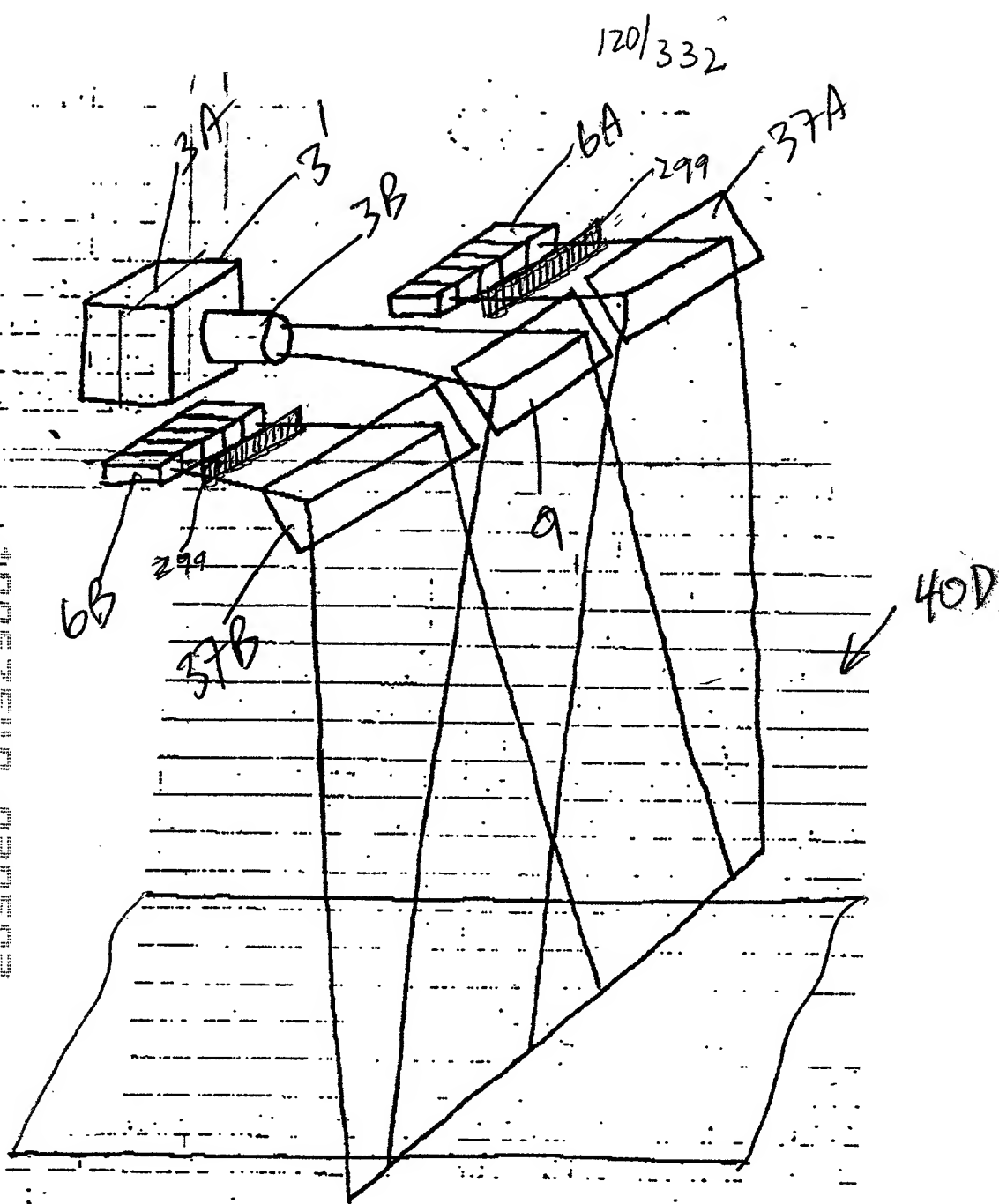


FIG. 2F1

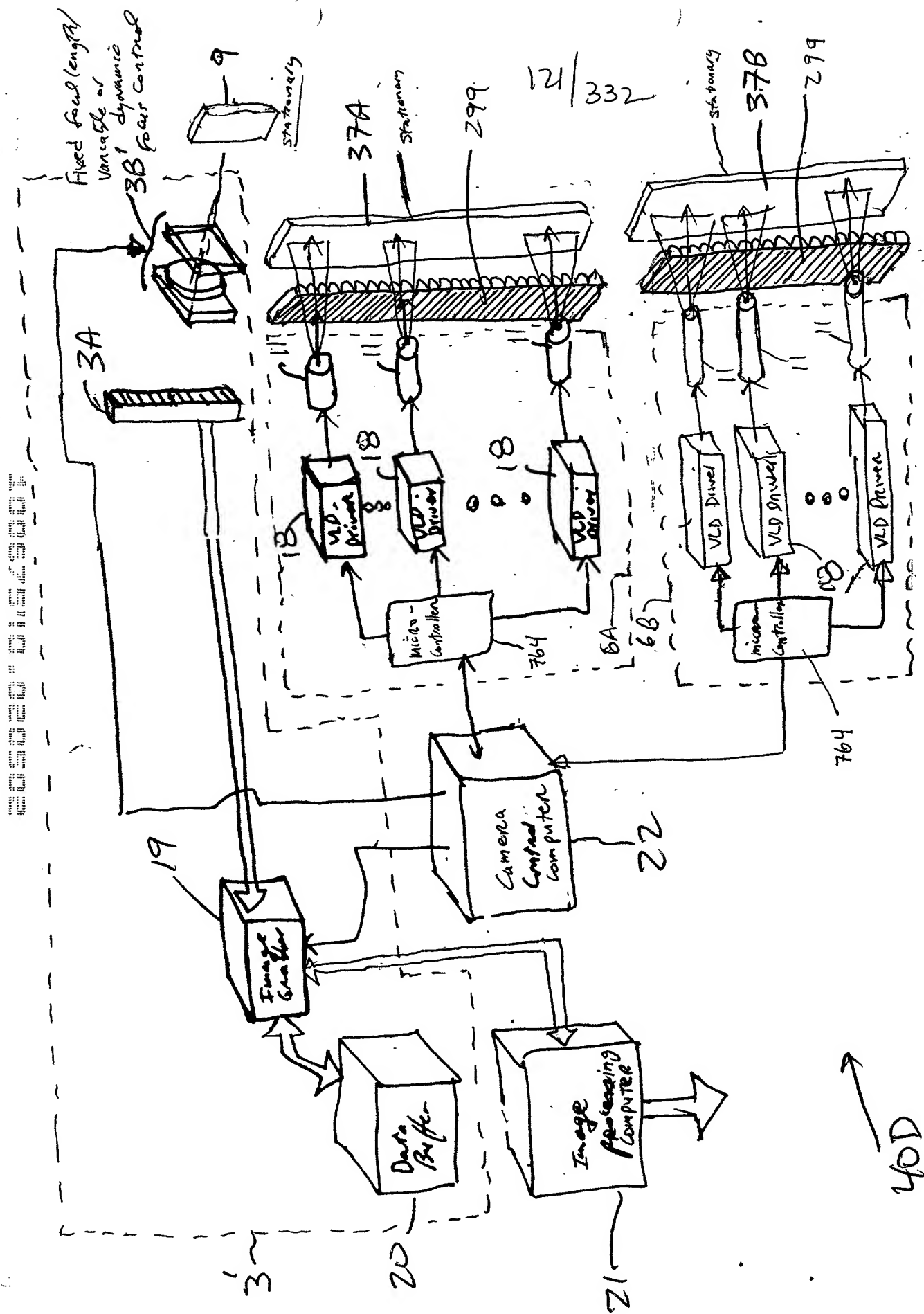


FIG 2FZ

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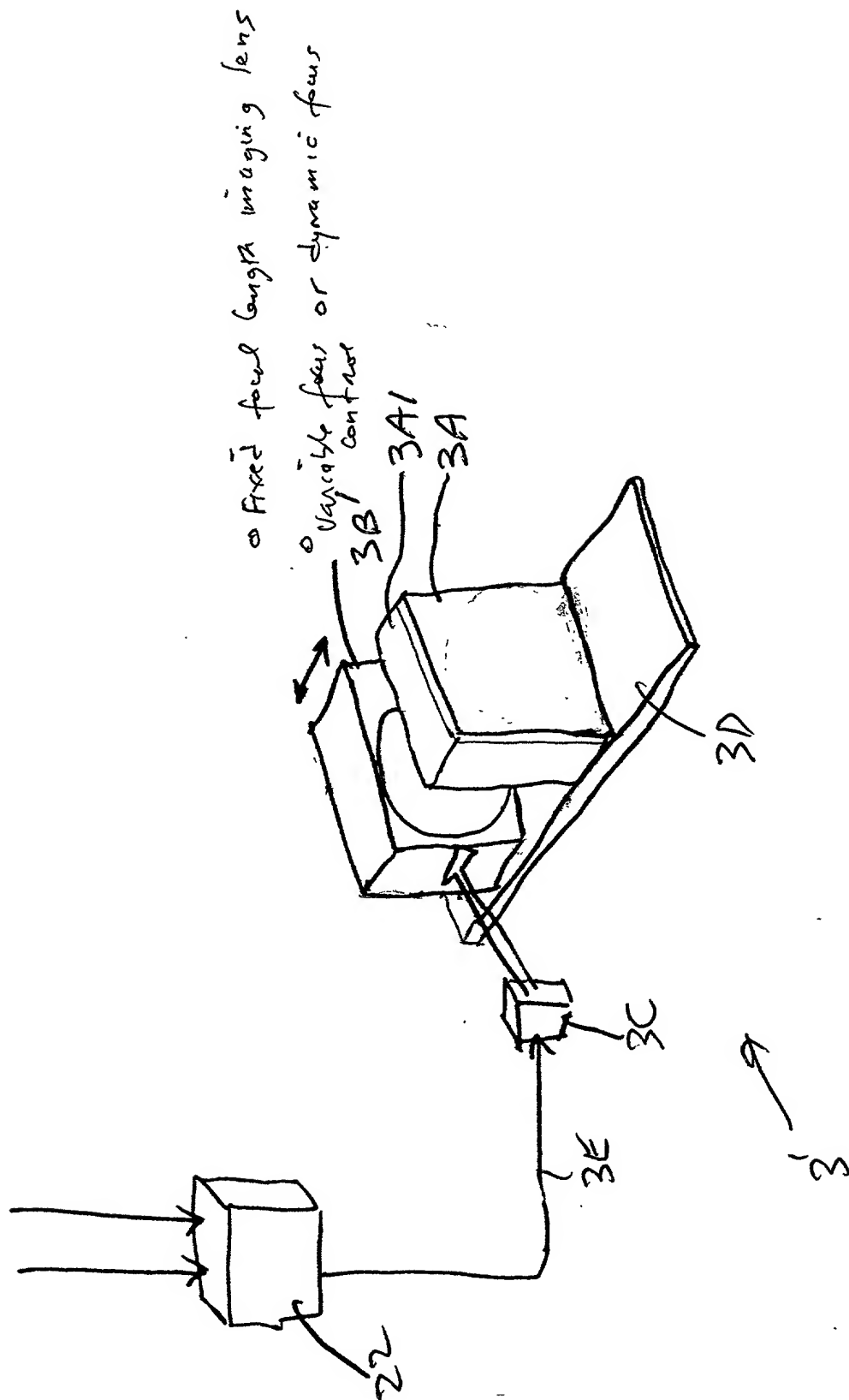


FIG. 2F3

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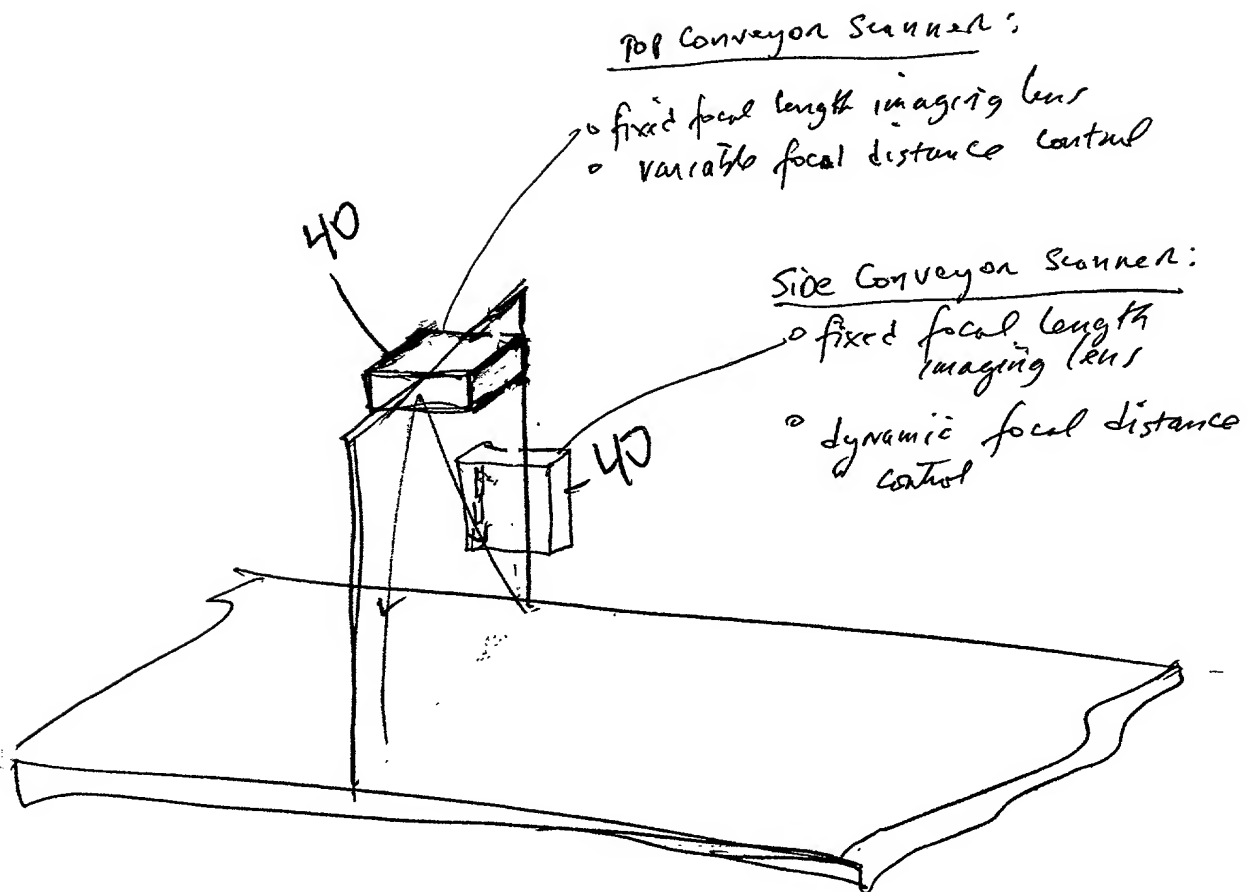


FIG. 2G

Fig. 2H

- Application:
- the 1st Summer
- Prostration Summer

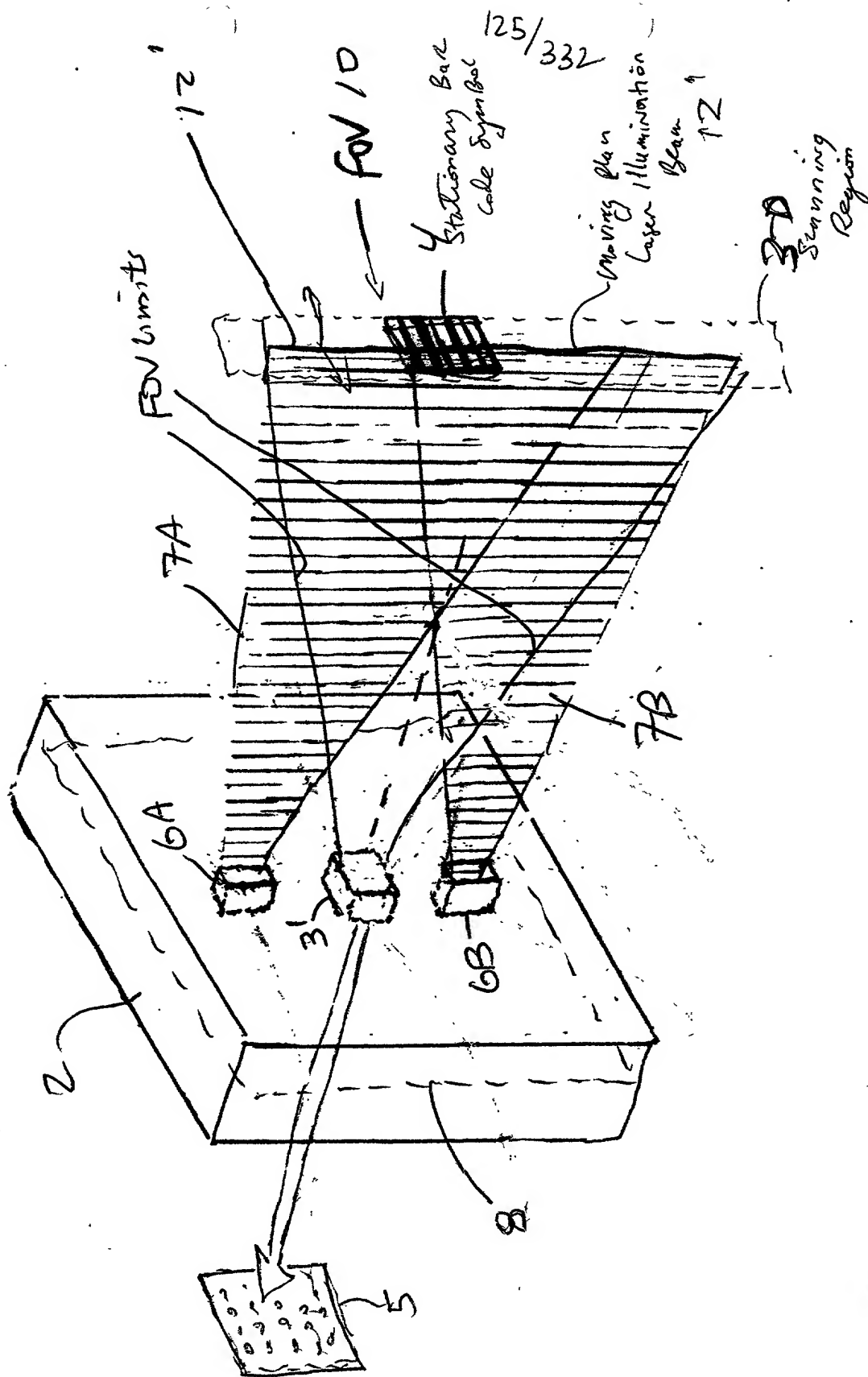
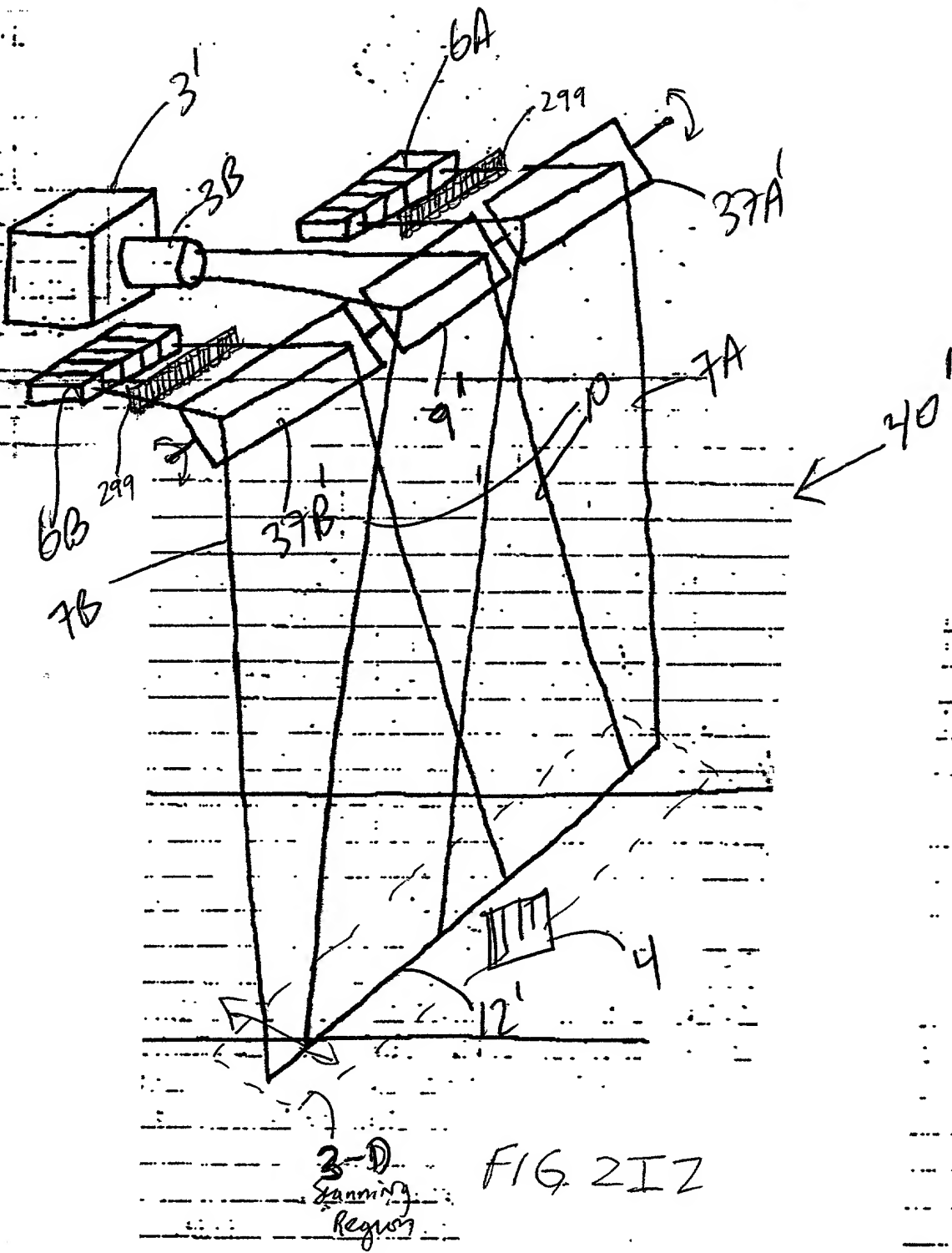


FIG. 211



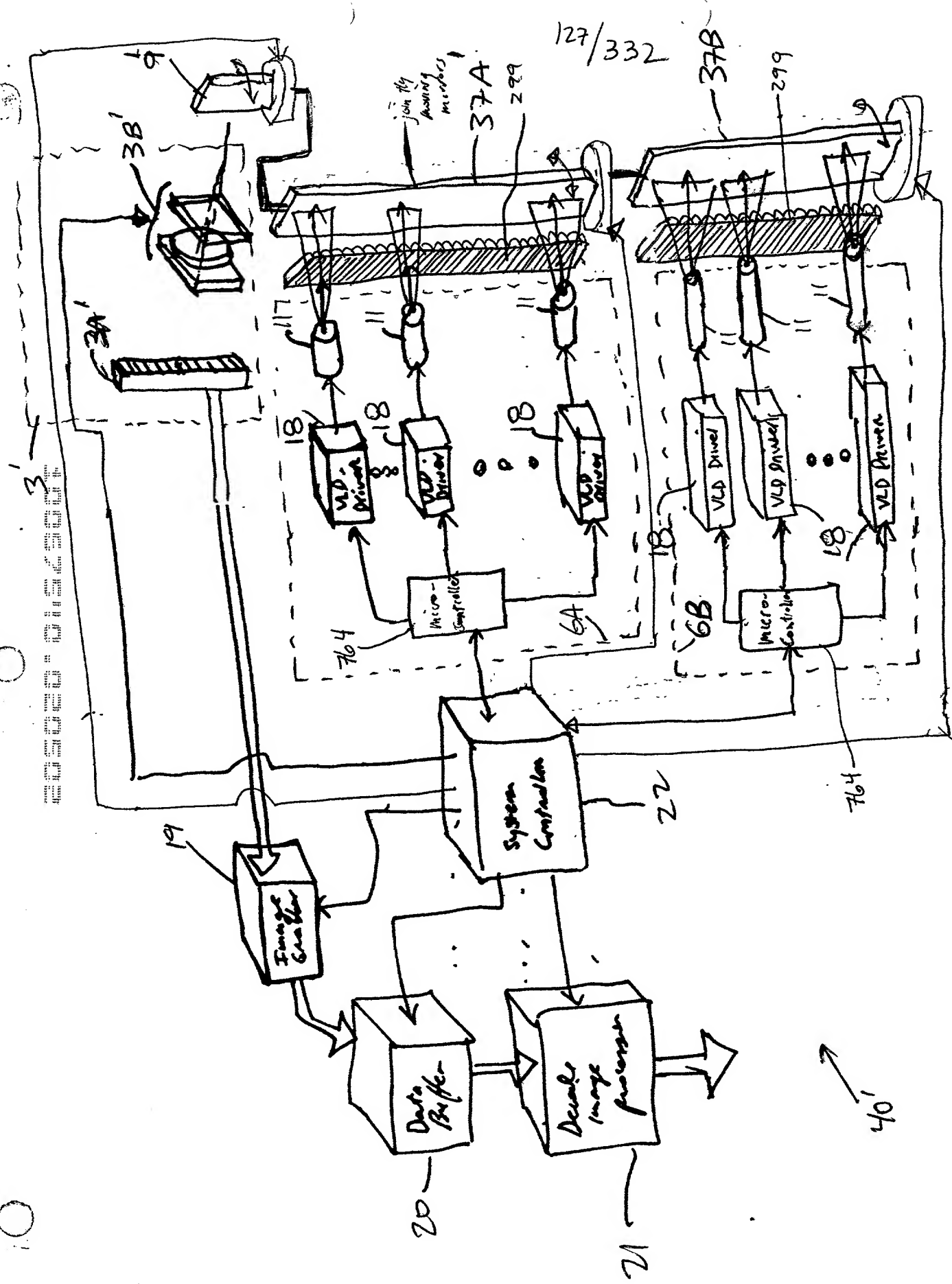


FIG. 2I3

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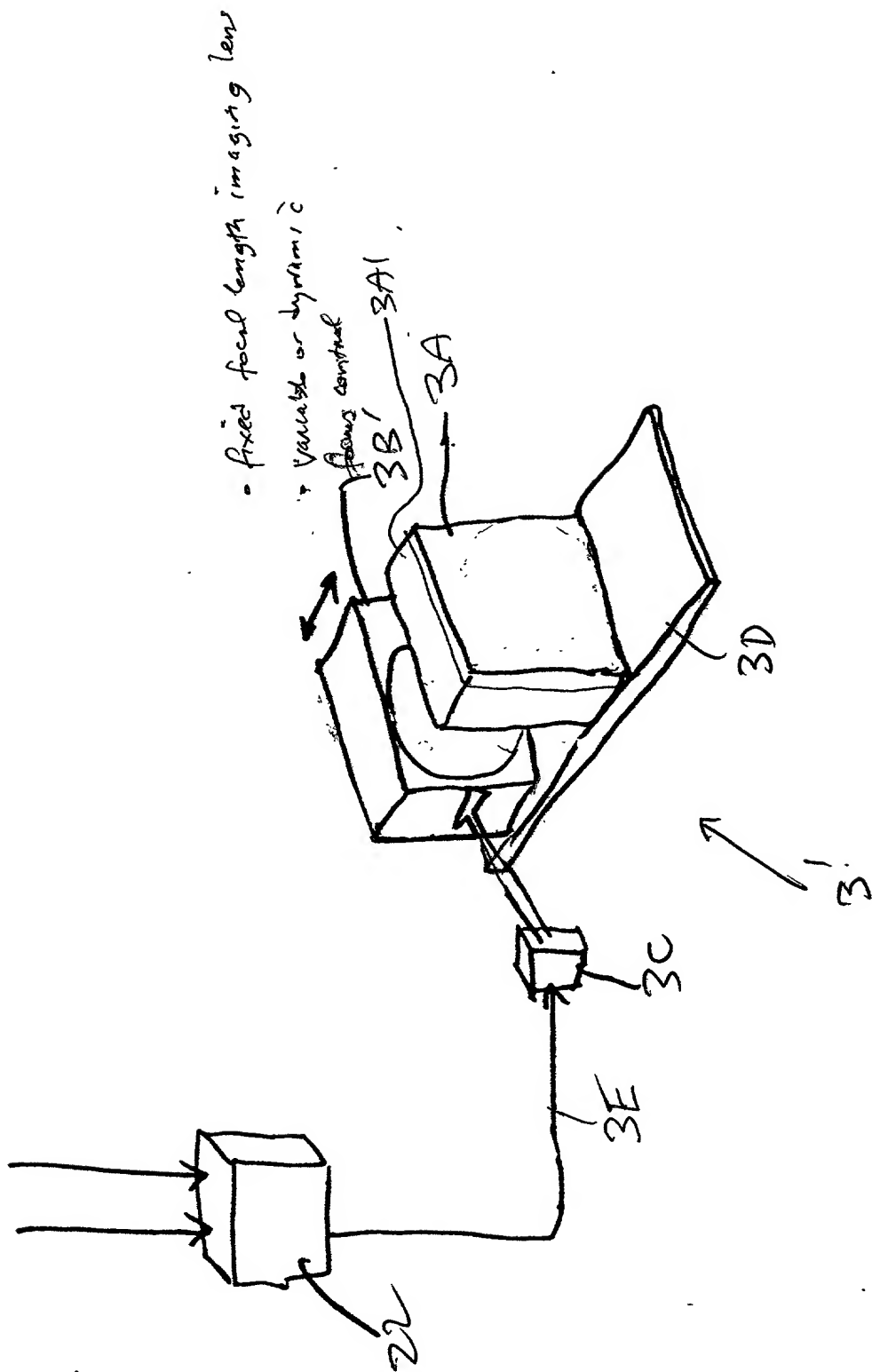


FIG. 2I4

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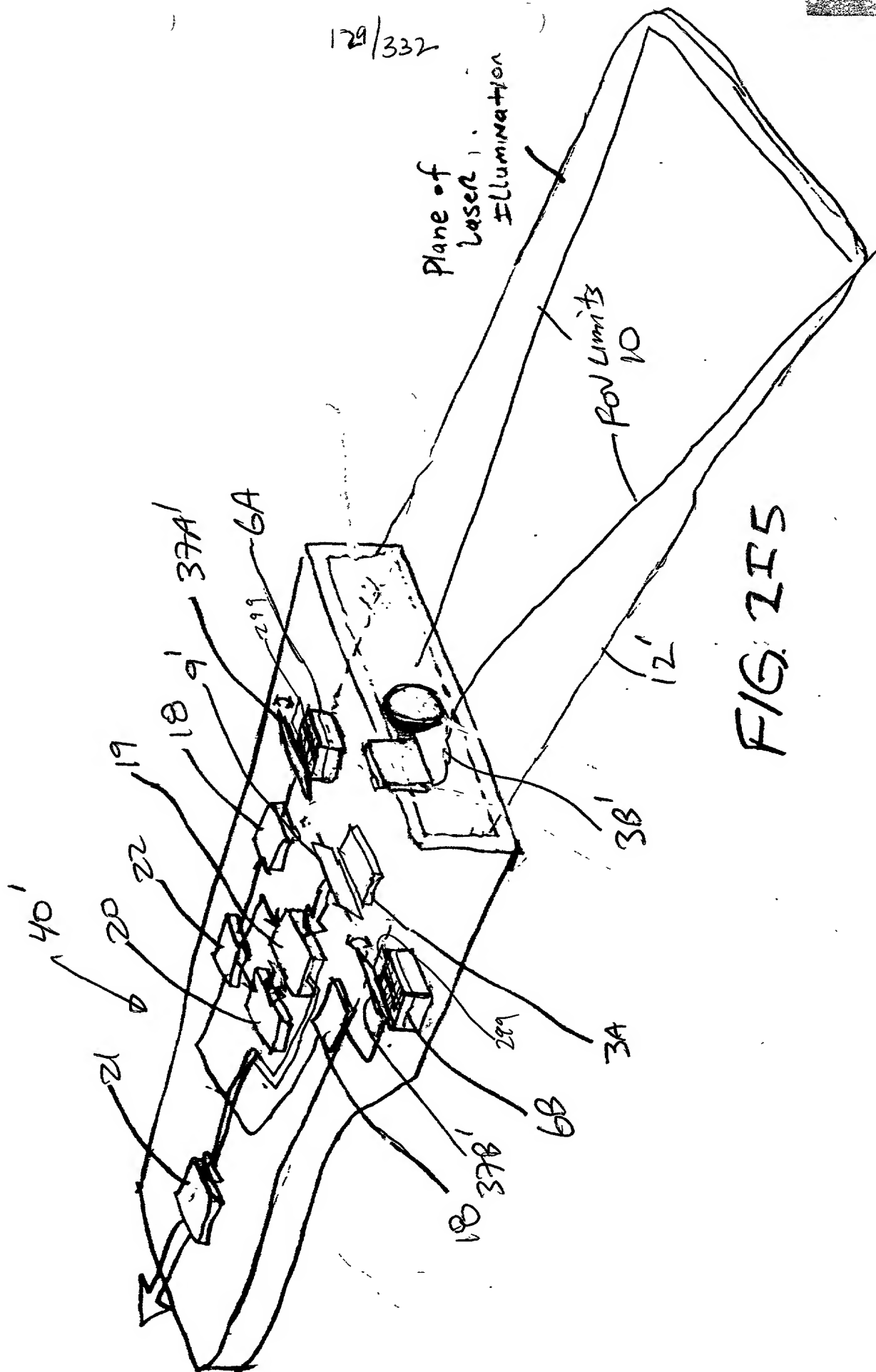


FIG. 215

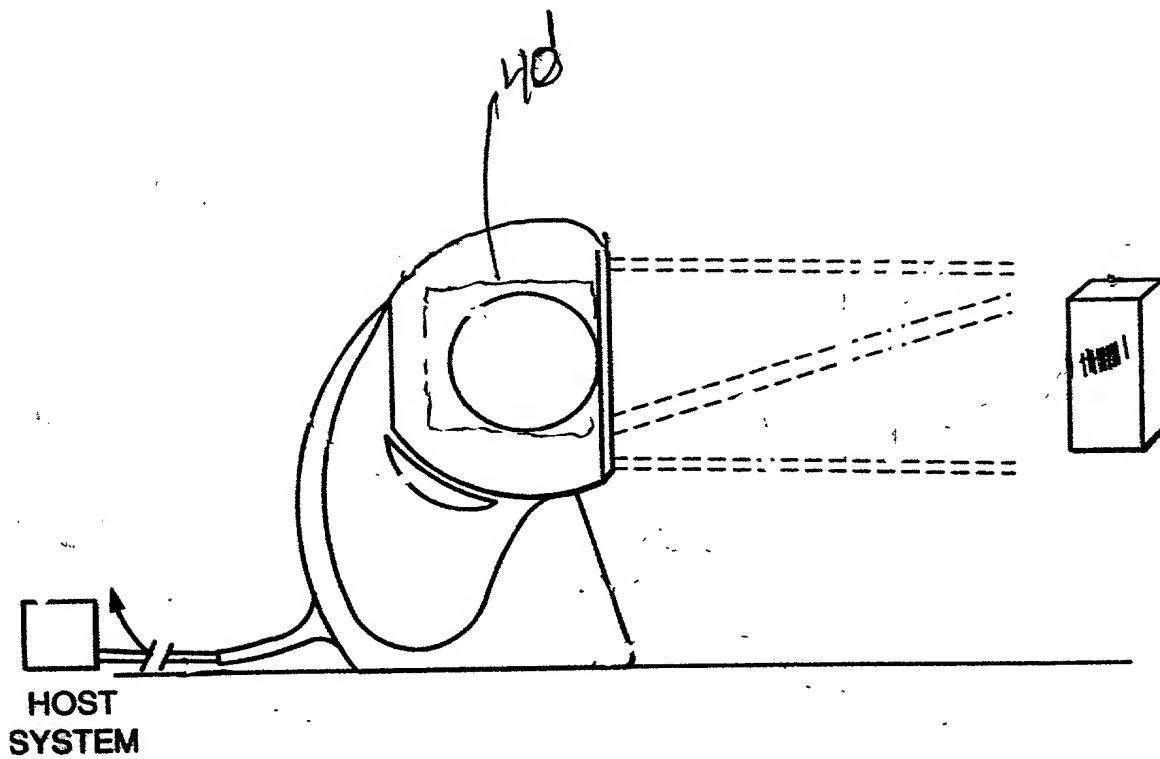


FIG. 2I6

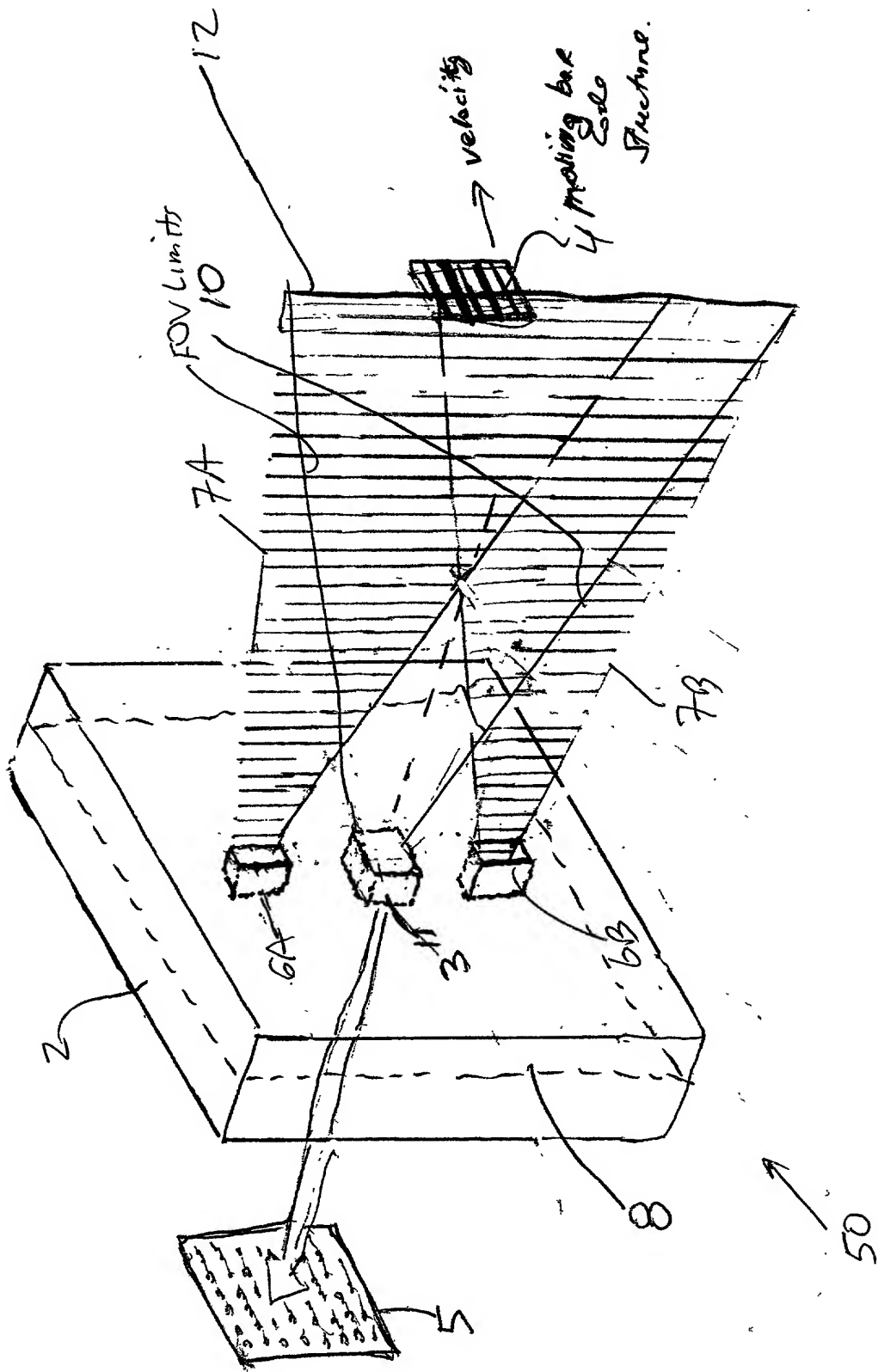


FIG 3A

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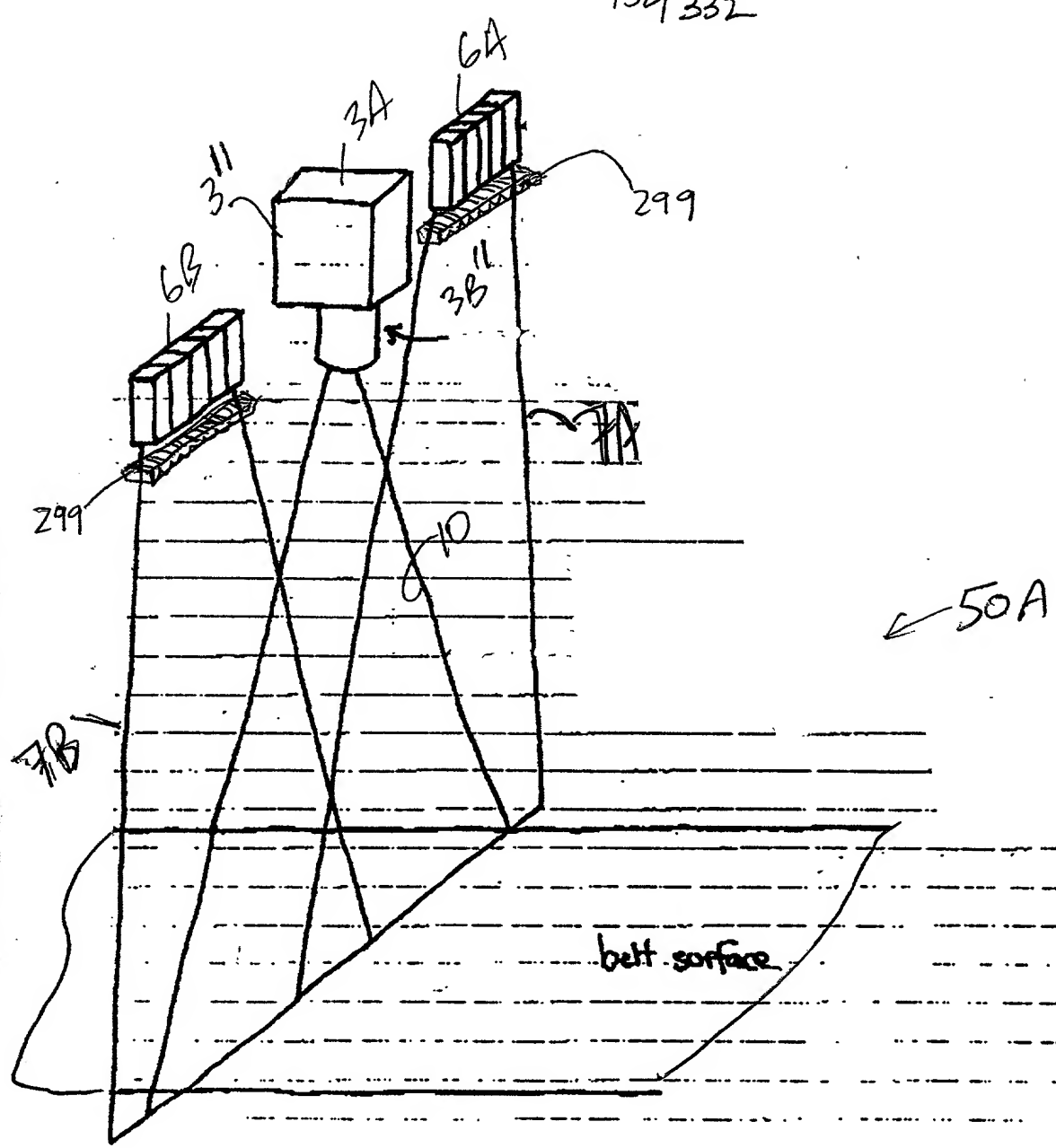


FIG. 3B1

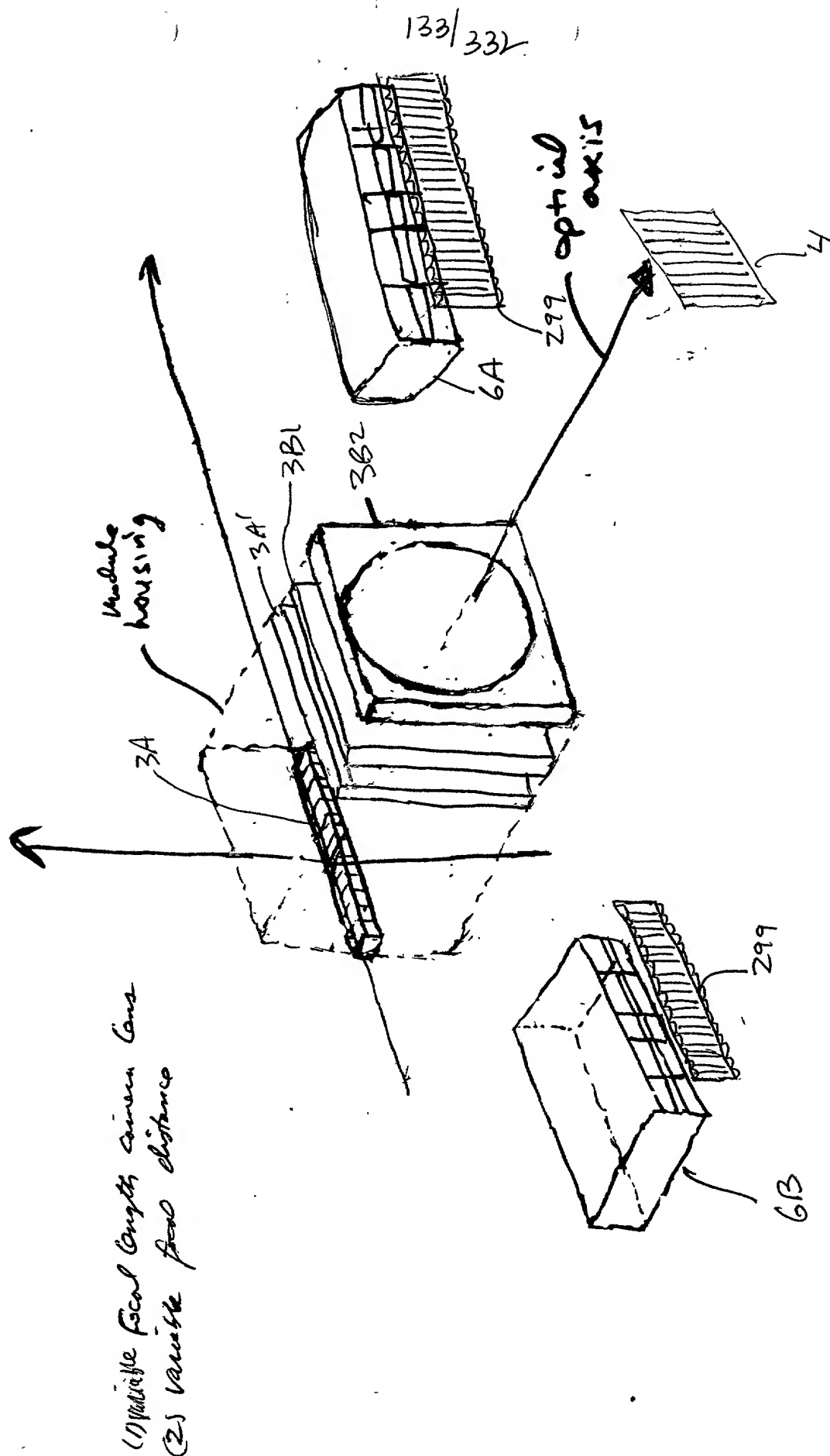


FIG. 3B2

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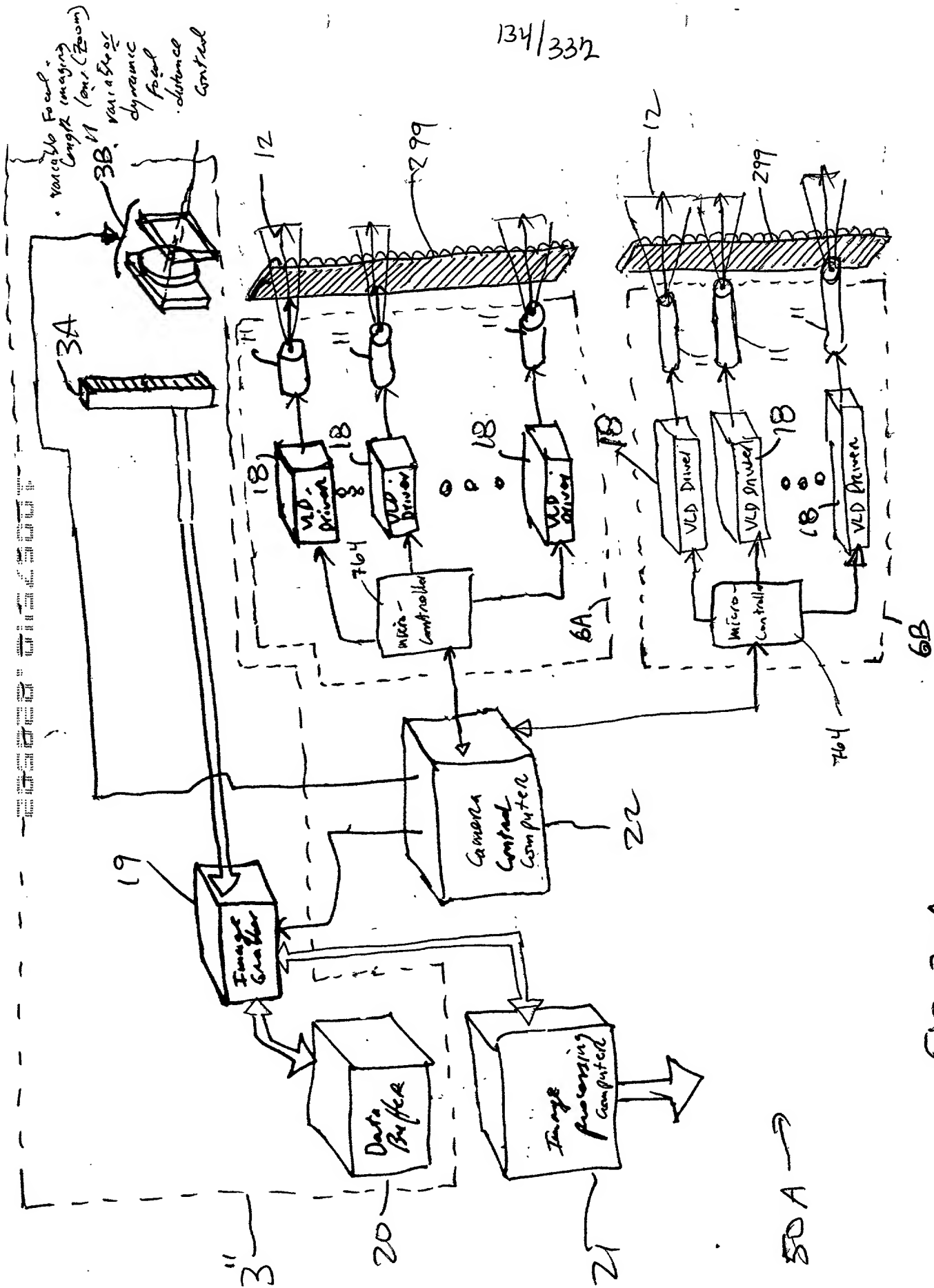
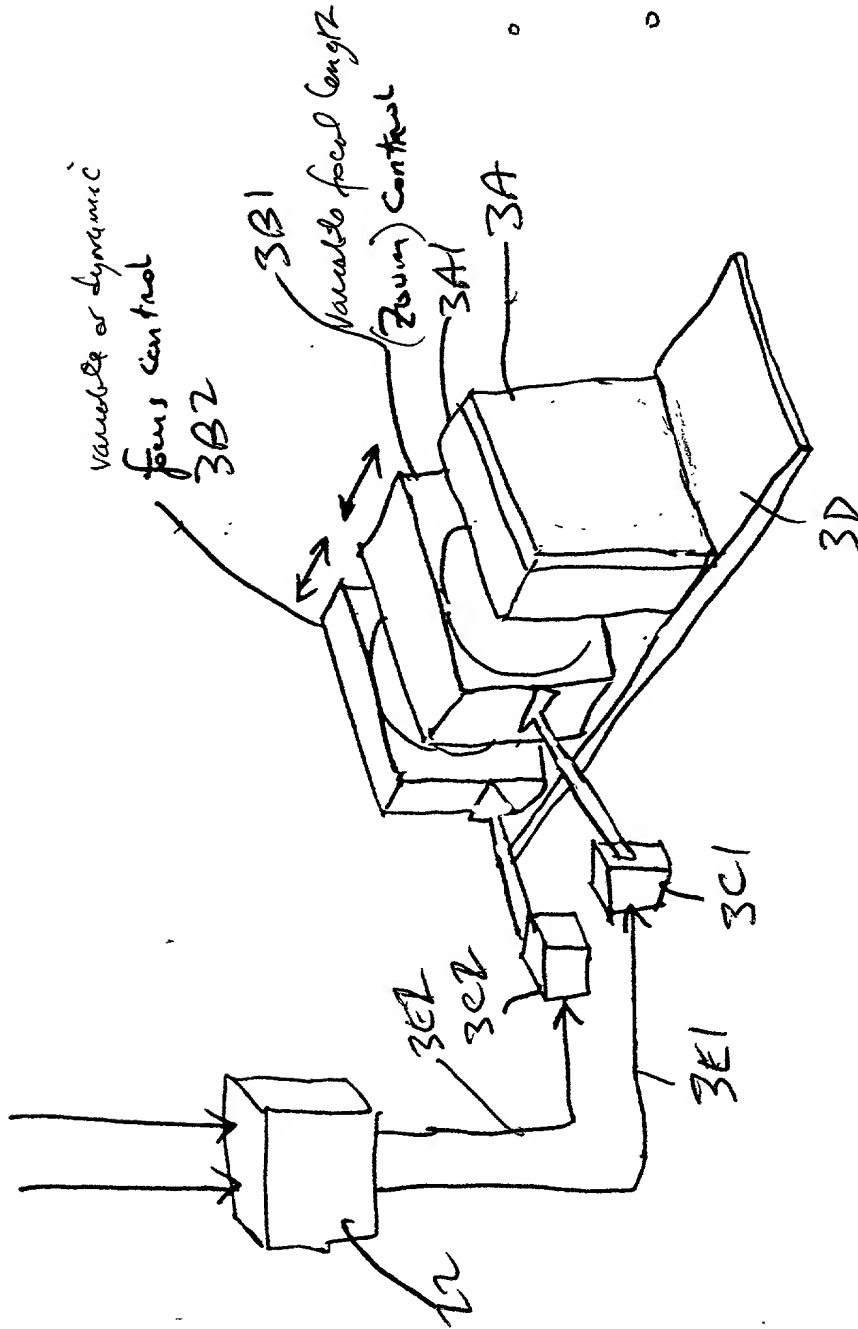


FIG 3C1

- Variable focal lengths cameras lens

- variable focal distance



3B1
Variable focal length
Zoom Control

341

3A

 Δ
3

361

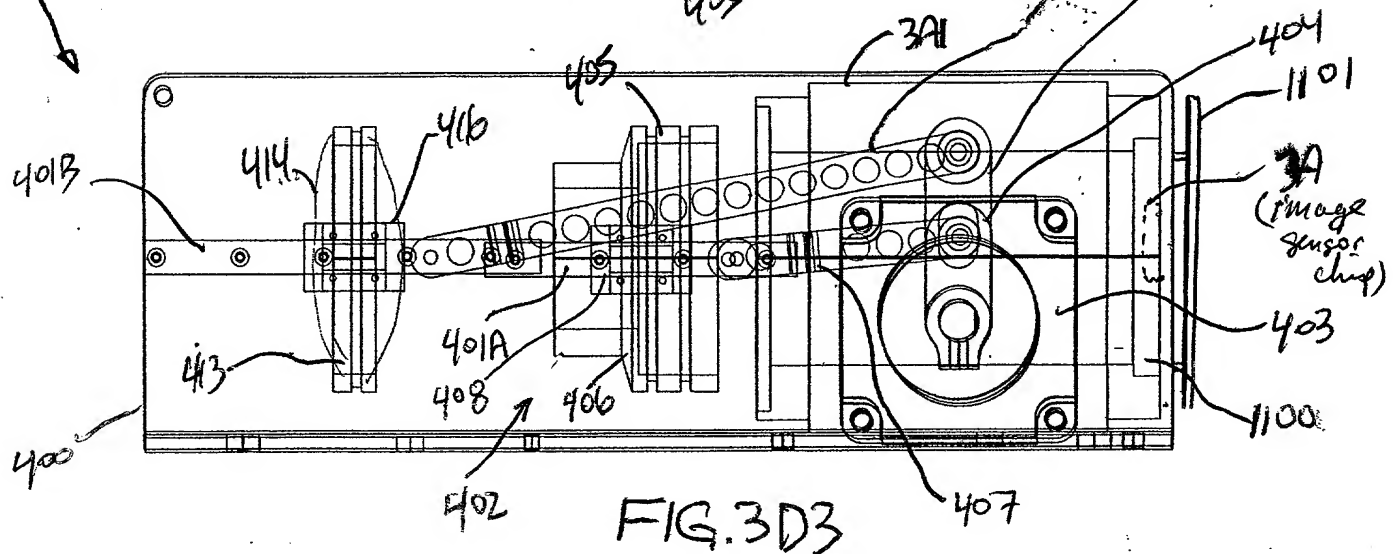
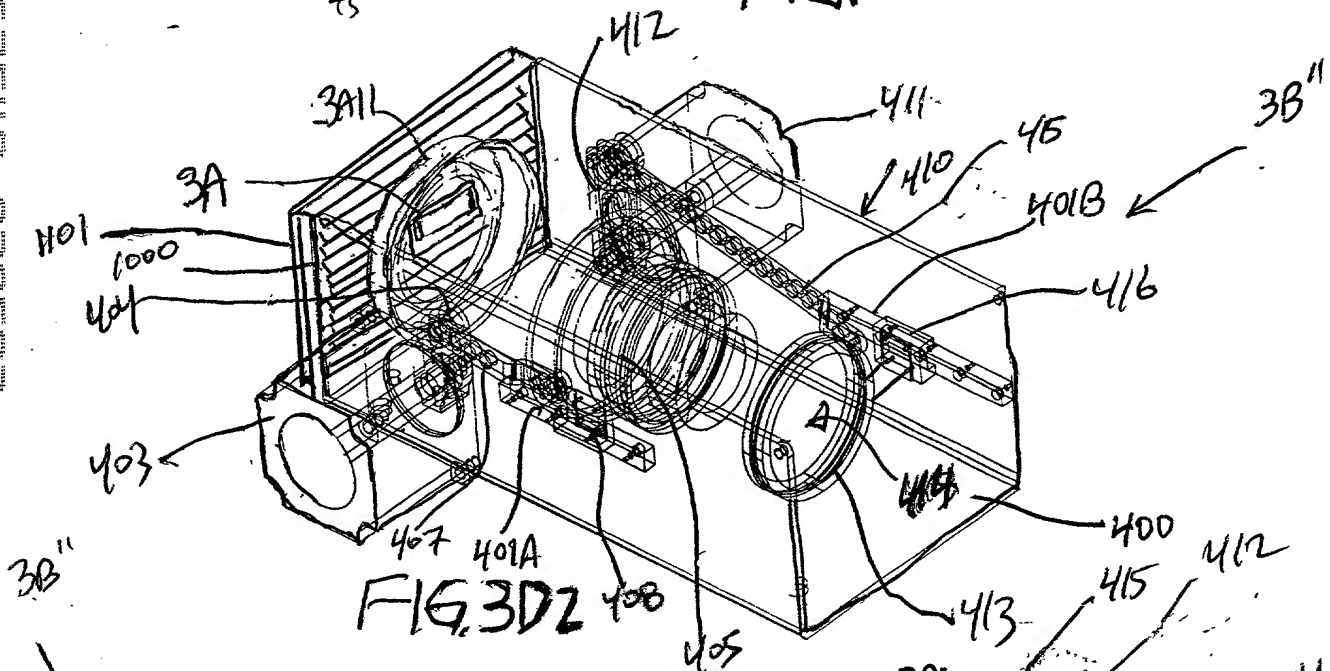
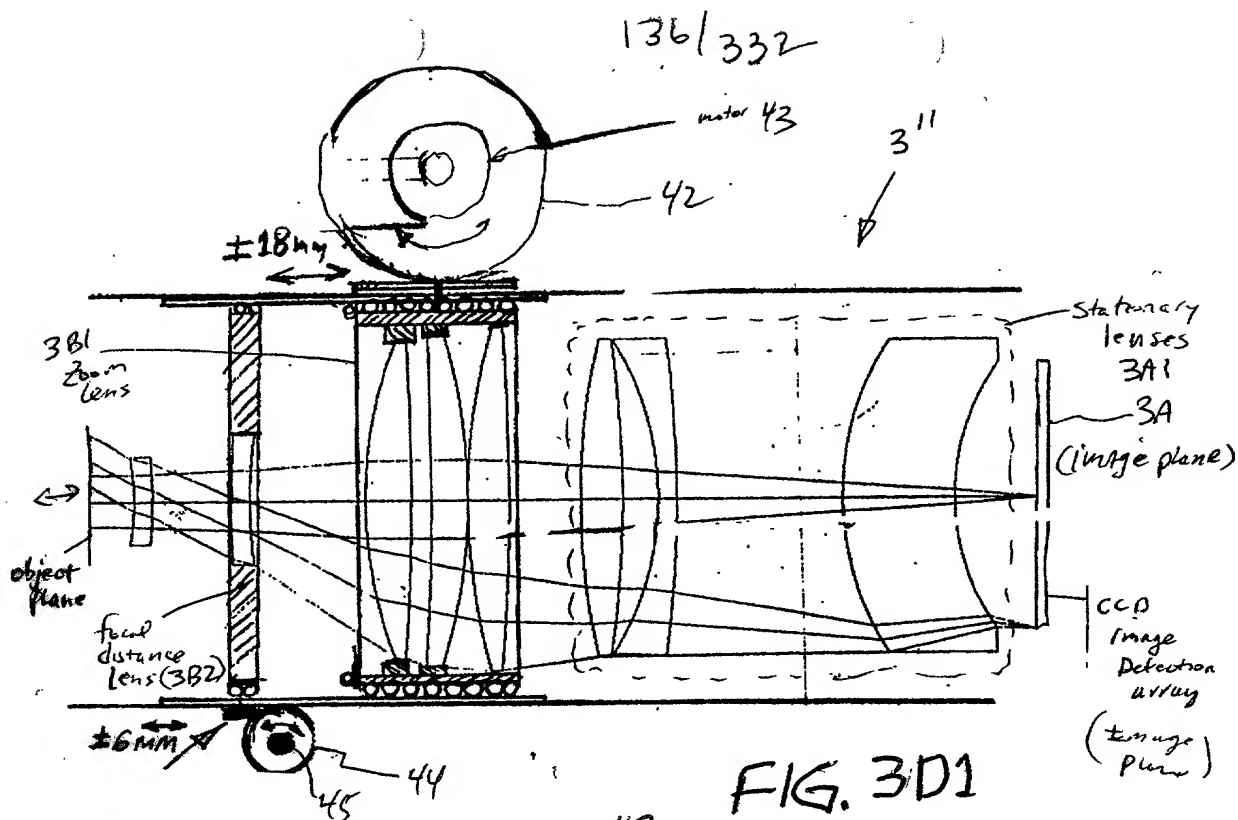
352

302

3E1

113

FIG. 3CZ



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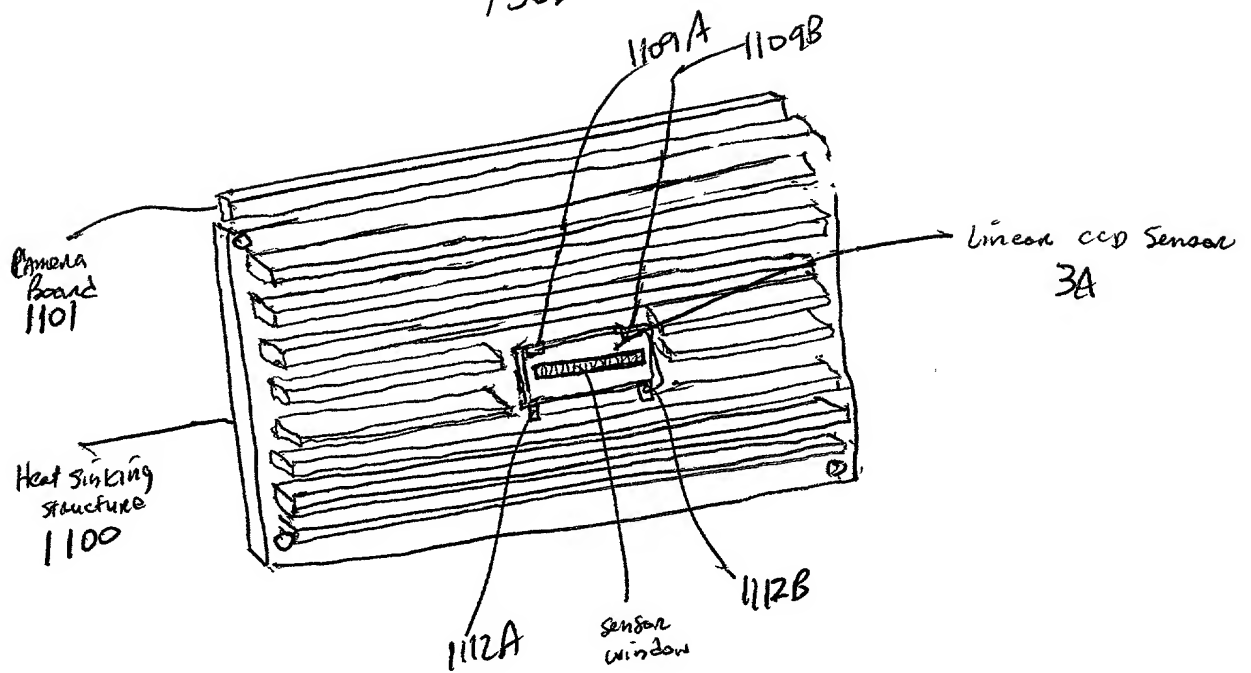


FIG. 3D4

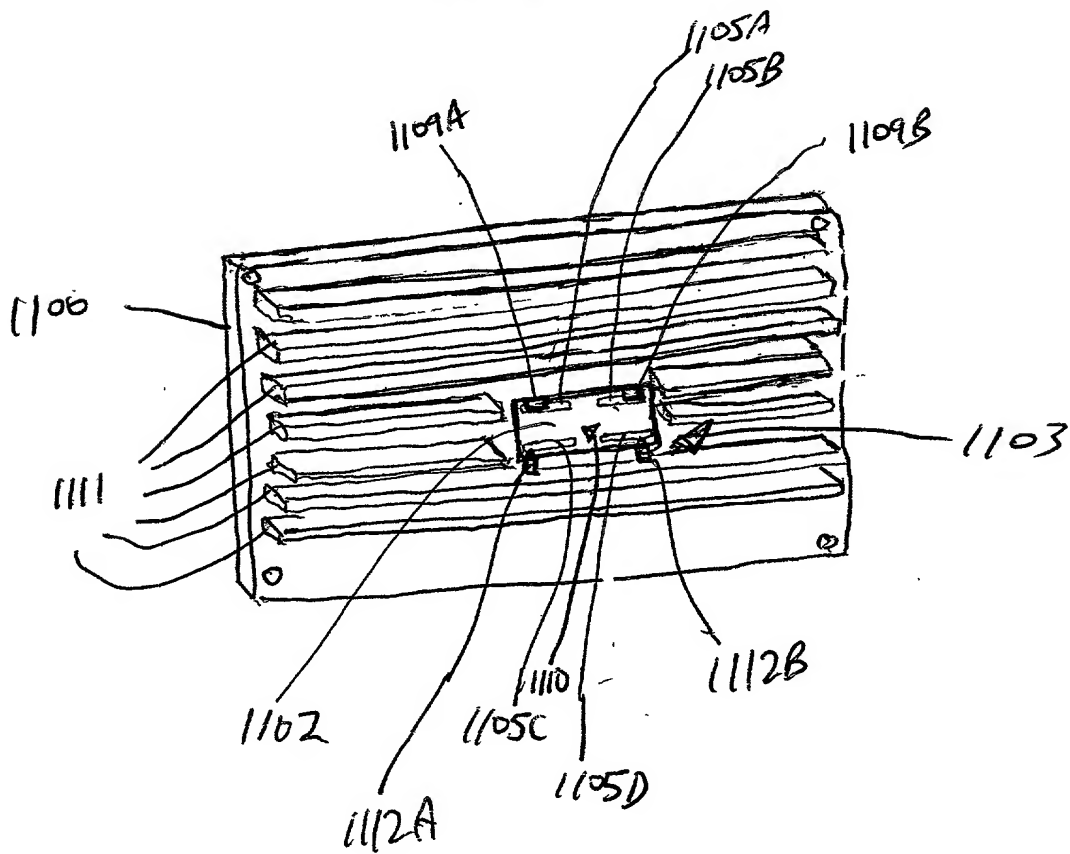


FIG. 3D5

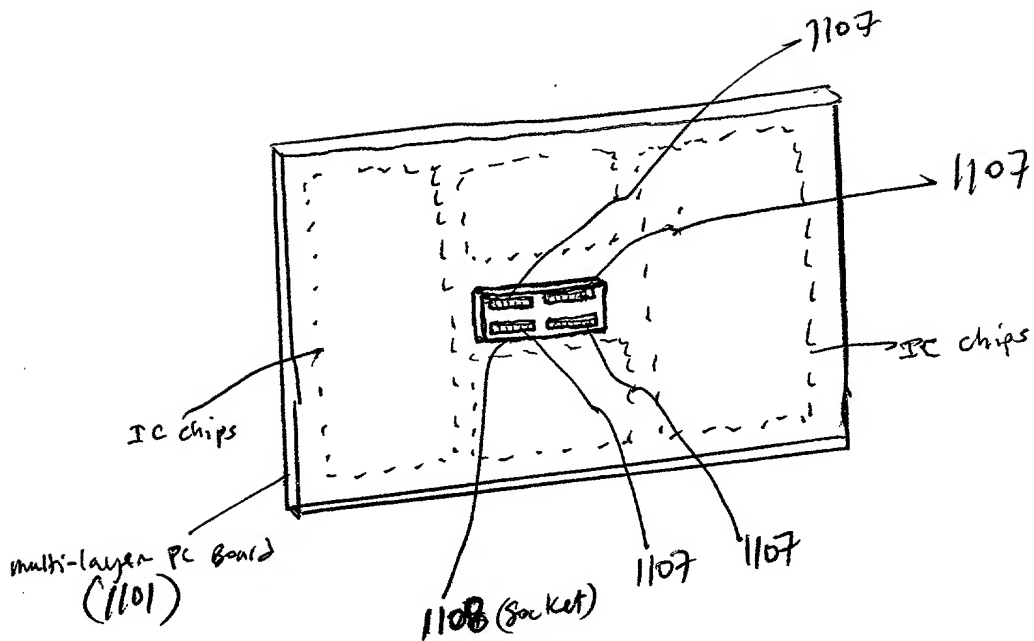


FIG. 3D6

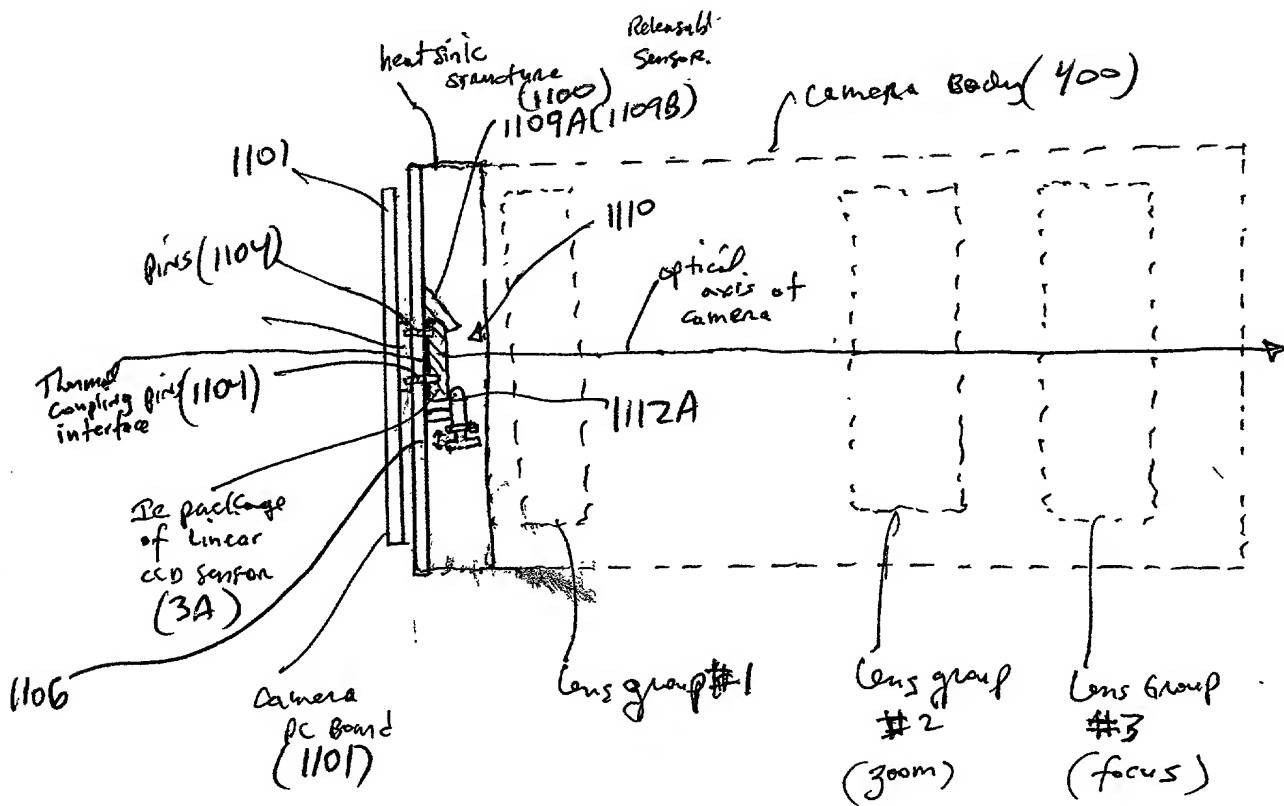
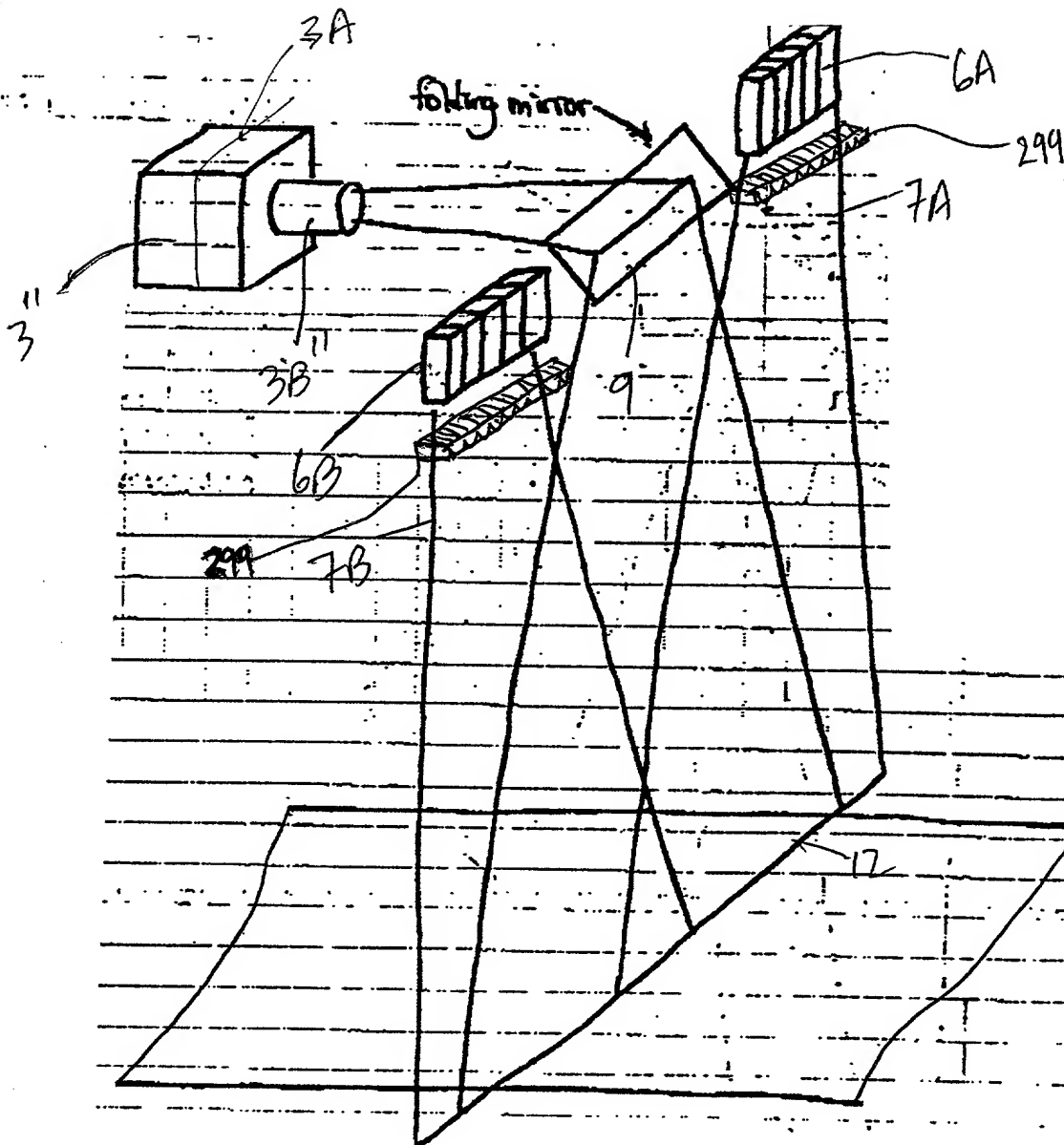


FIG. 3D7

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503

FIG. 3E1

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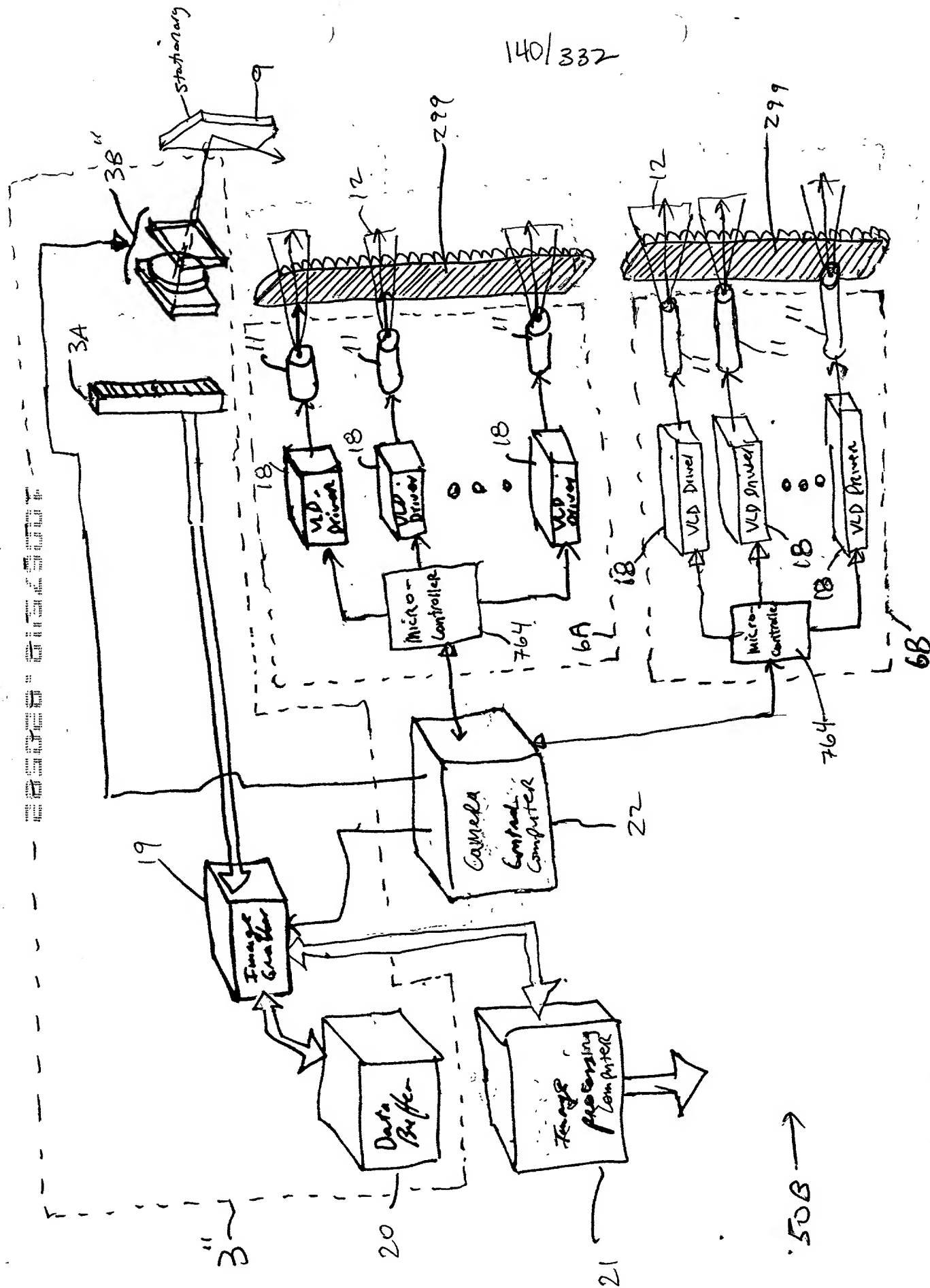


FIG. 3E2

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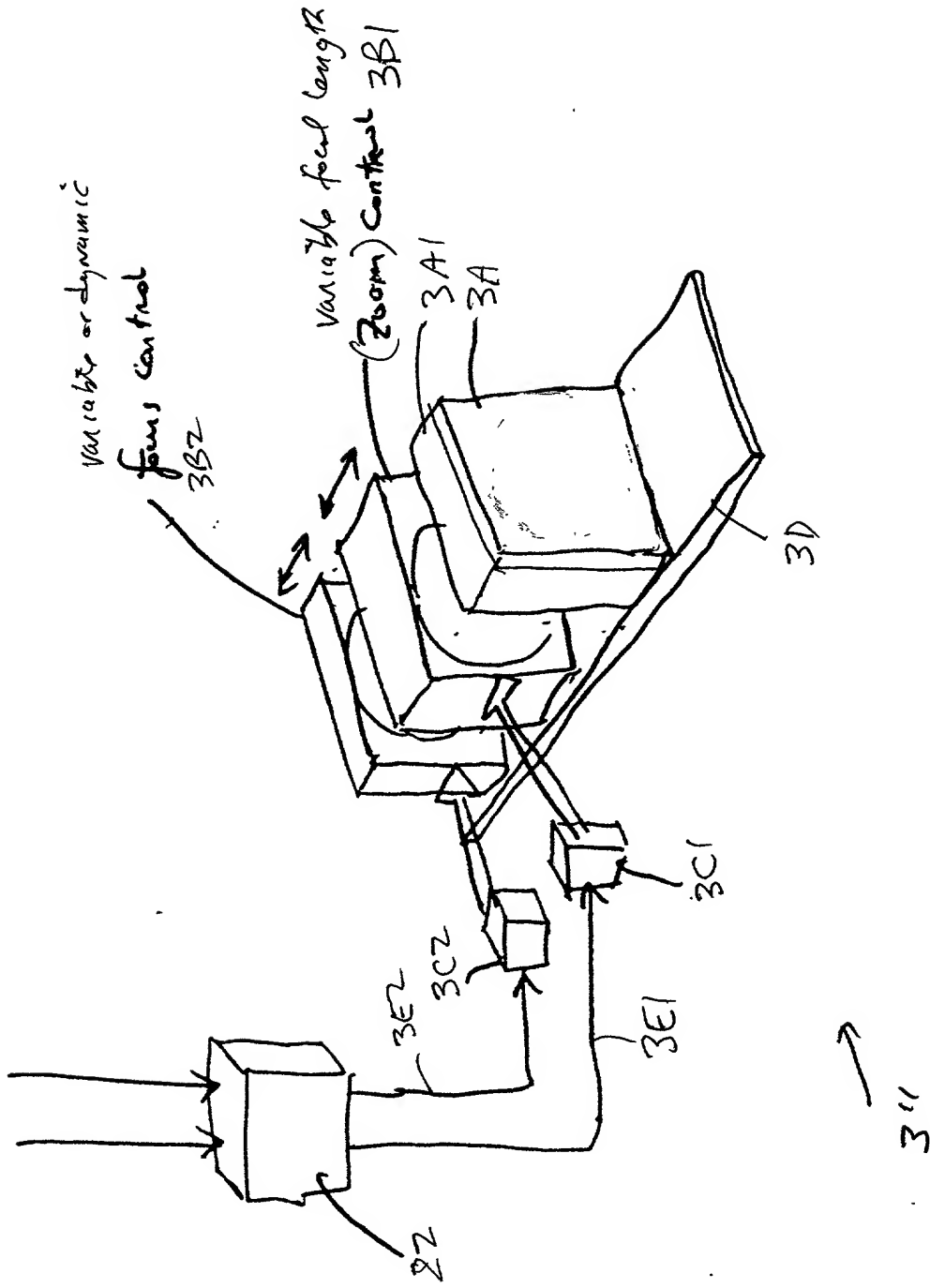
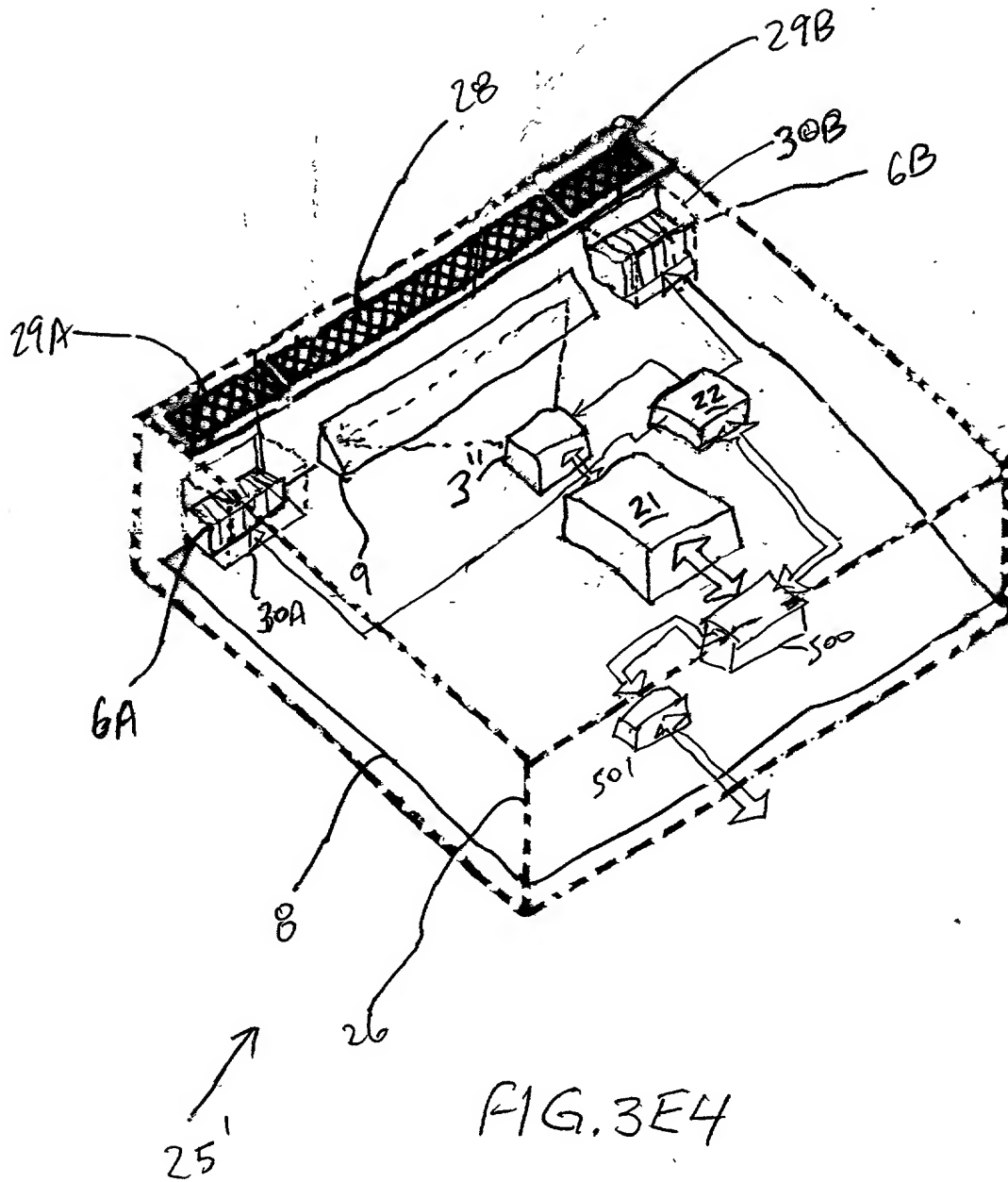


FIG. 3E3

142 | 332



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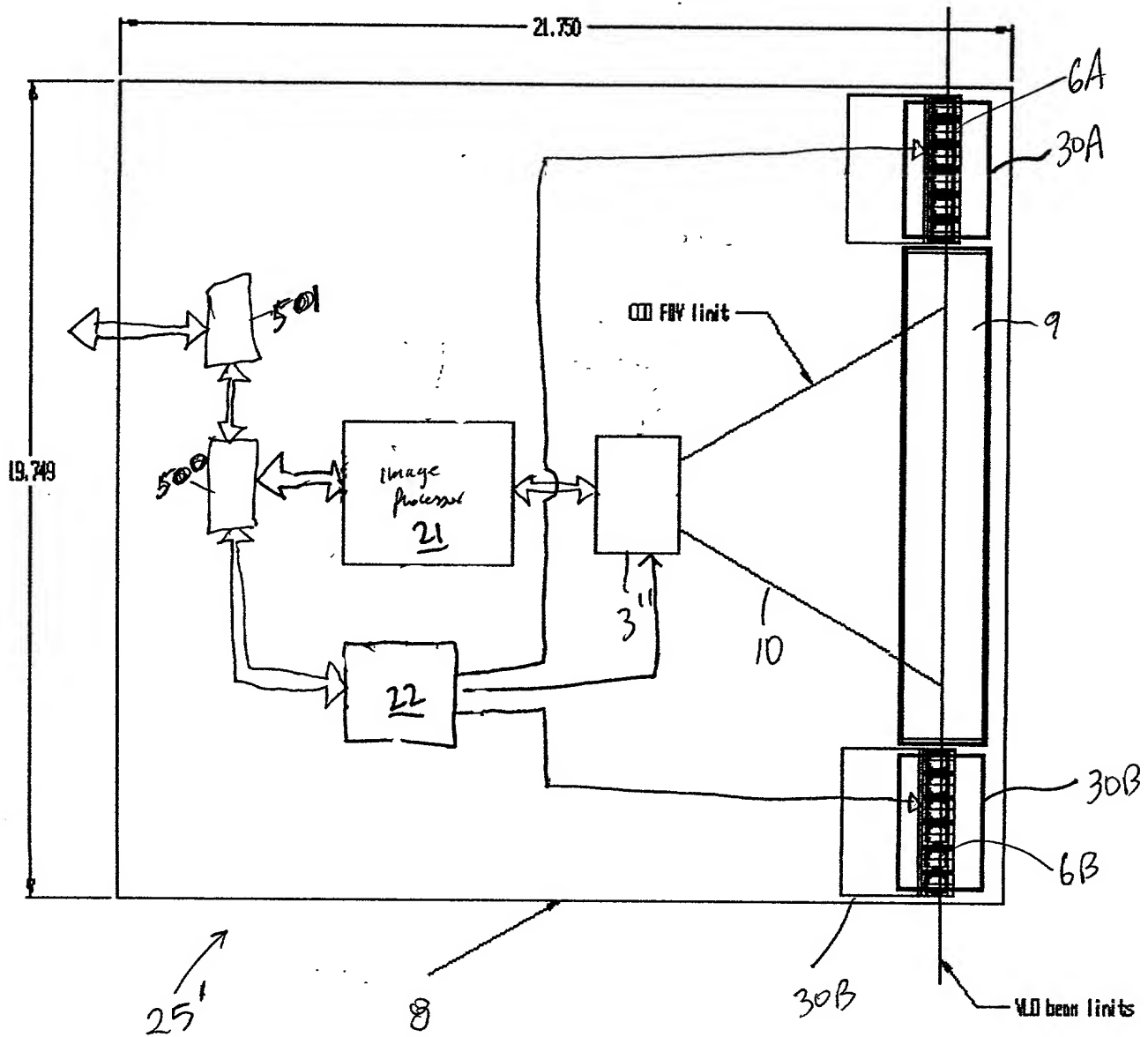


FIG. 3E5

FIG. 3E6

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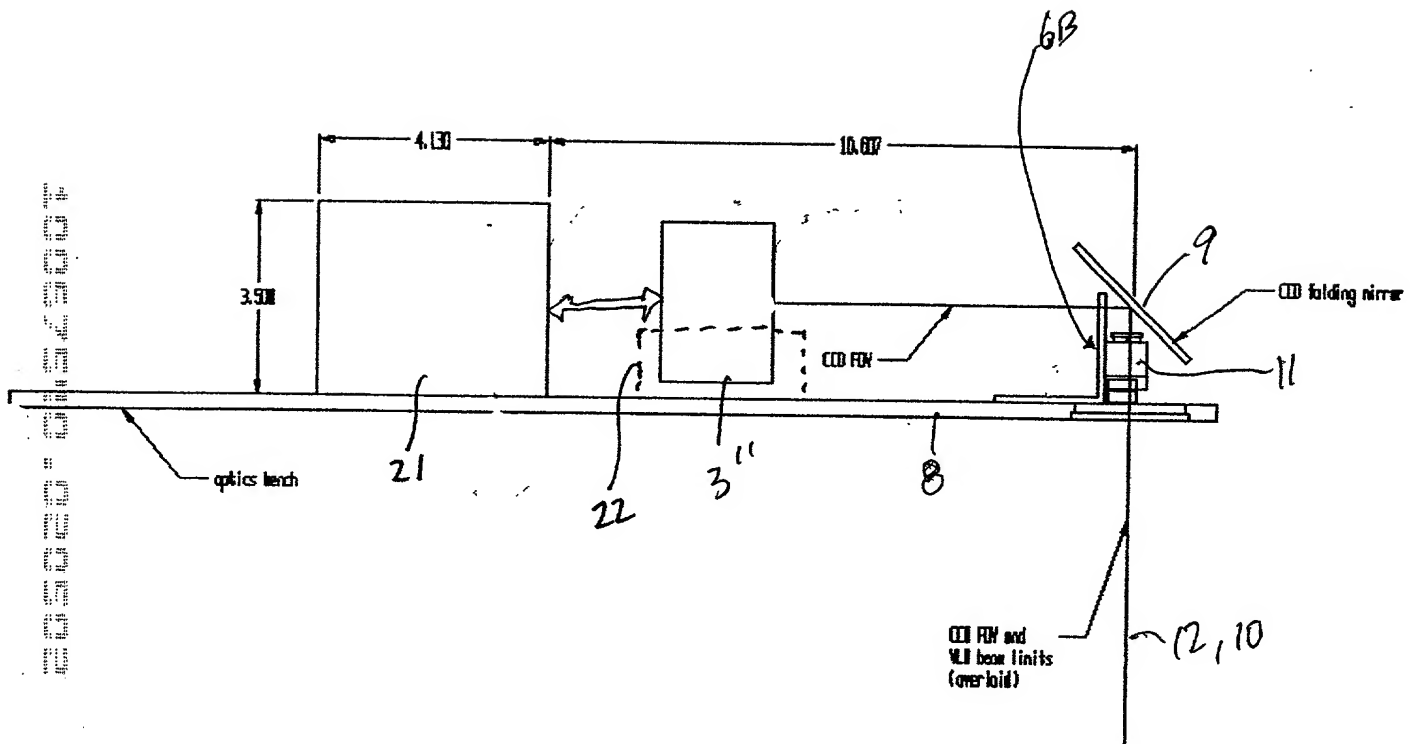


FIG. 3E7

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*Variable FOV

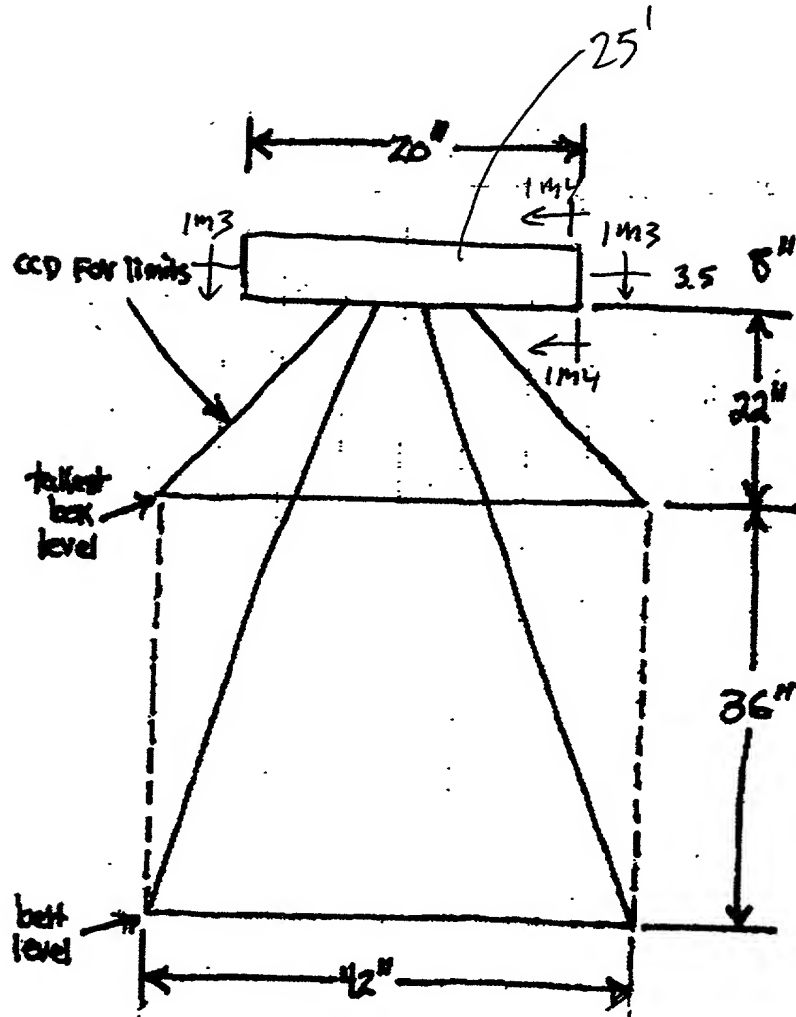


FIG. 3E8

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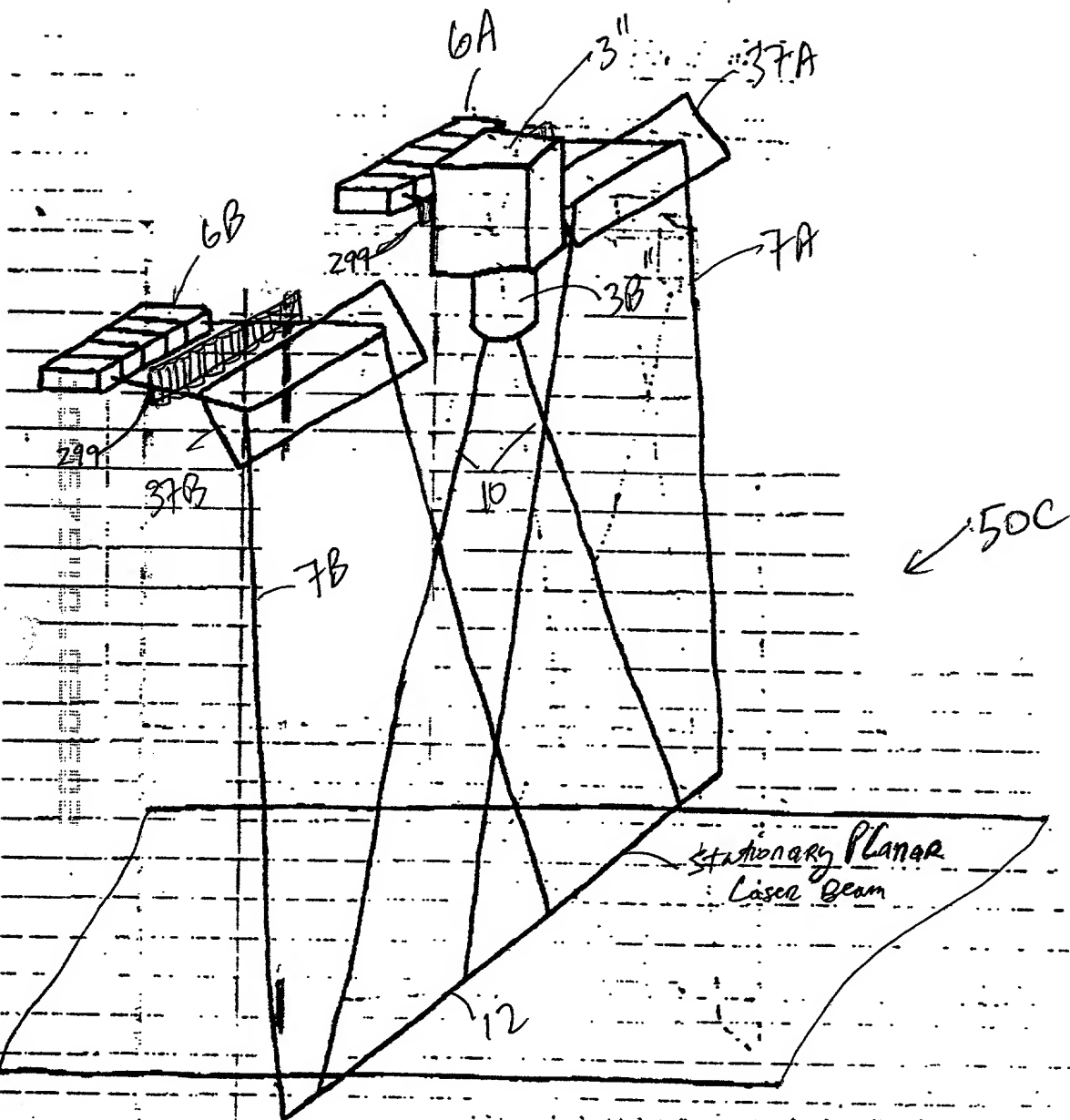


FIG. 3F1

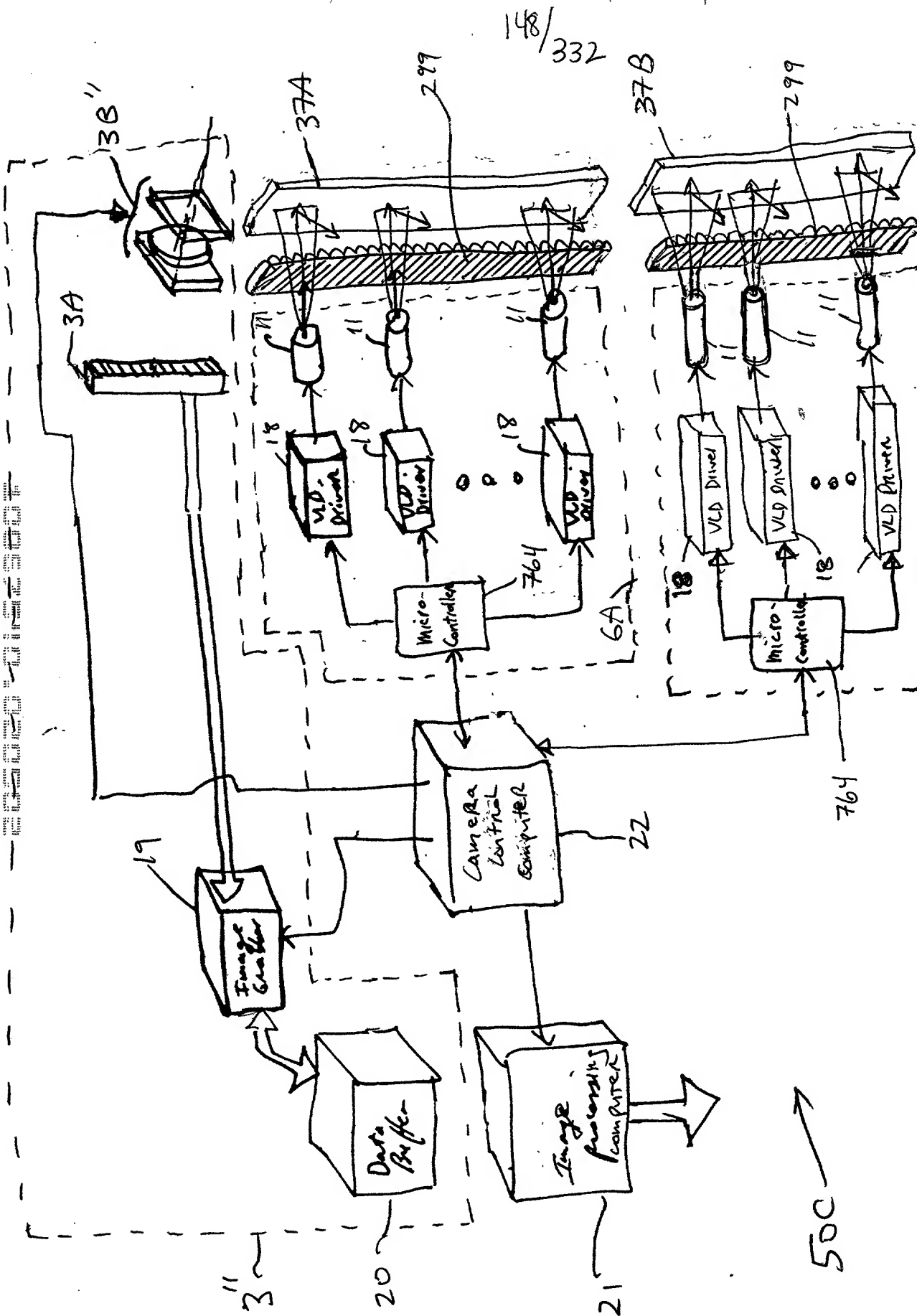


FIG. 3F2

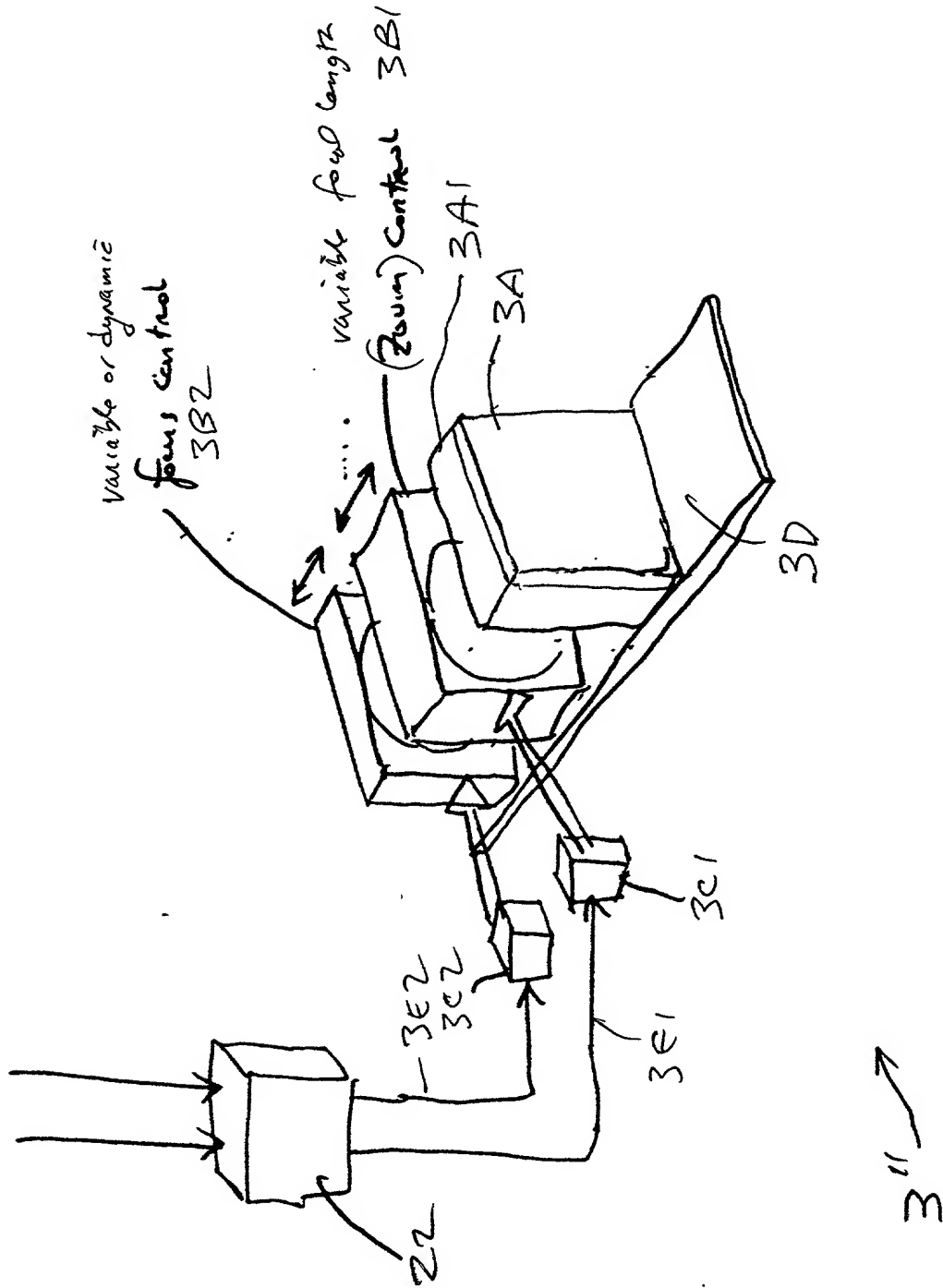


FIG. 3F3

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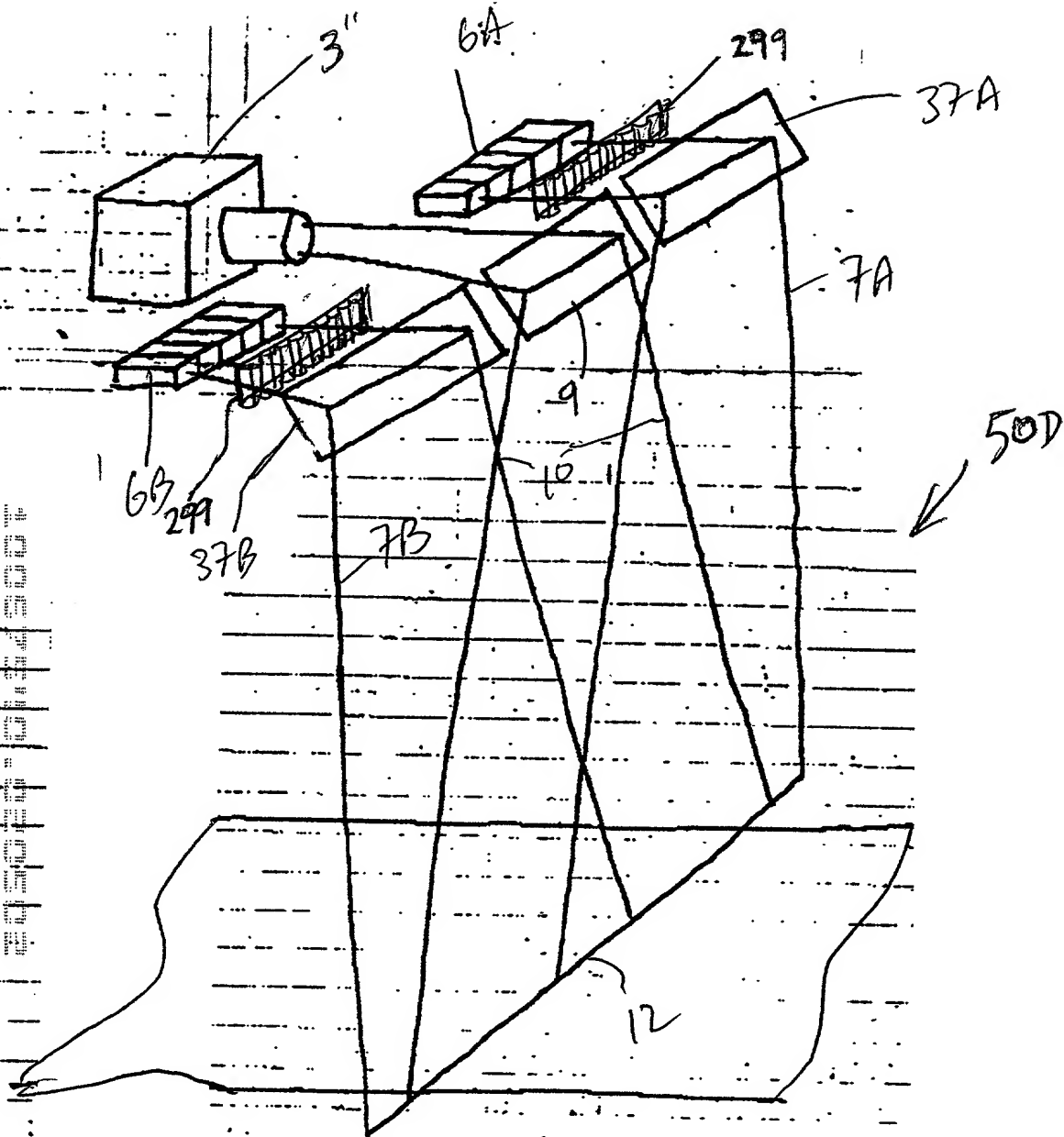


FIG. 351

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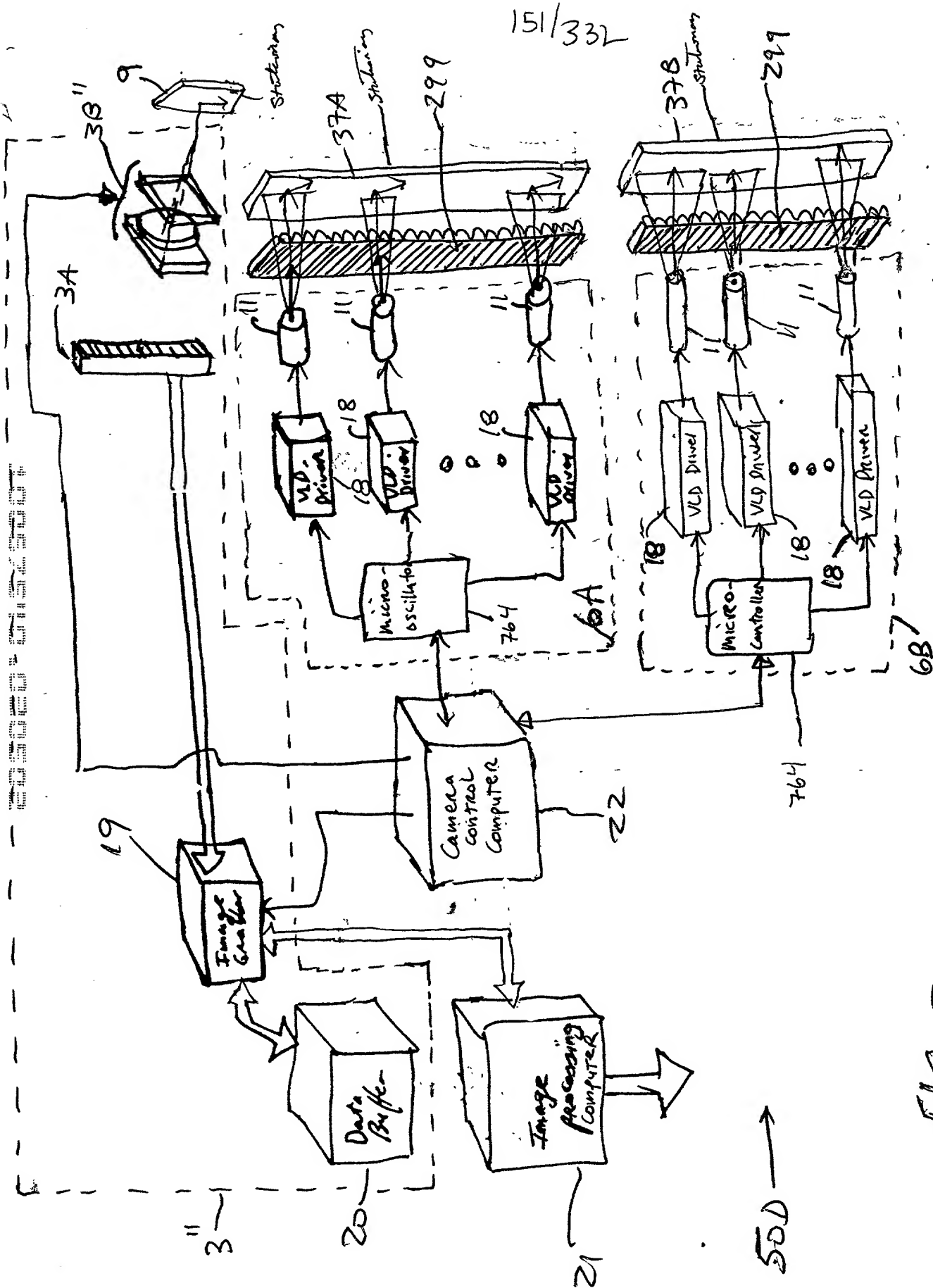


FIG. 362

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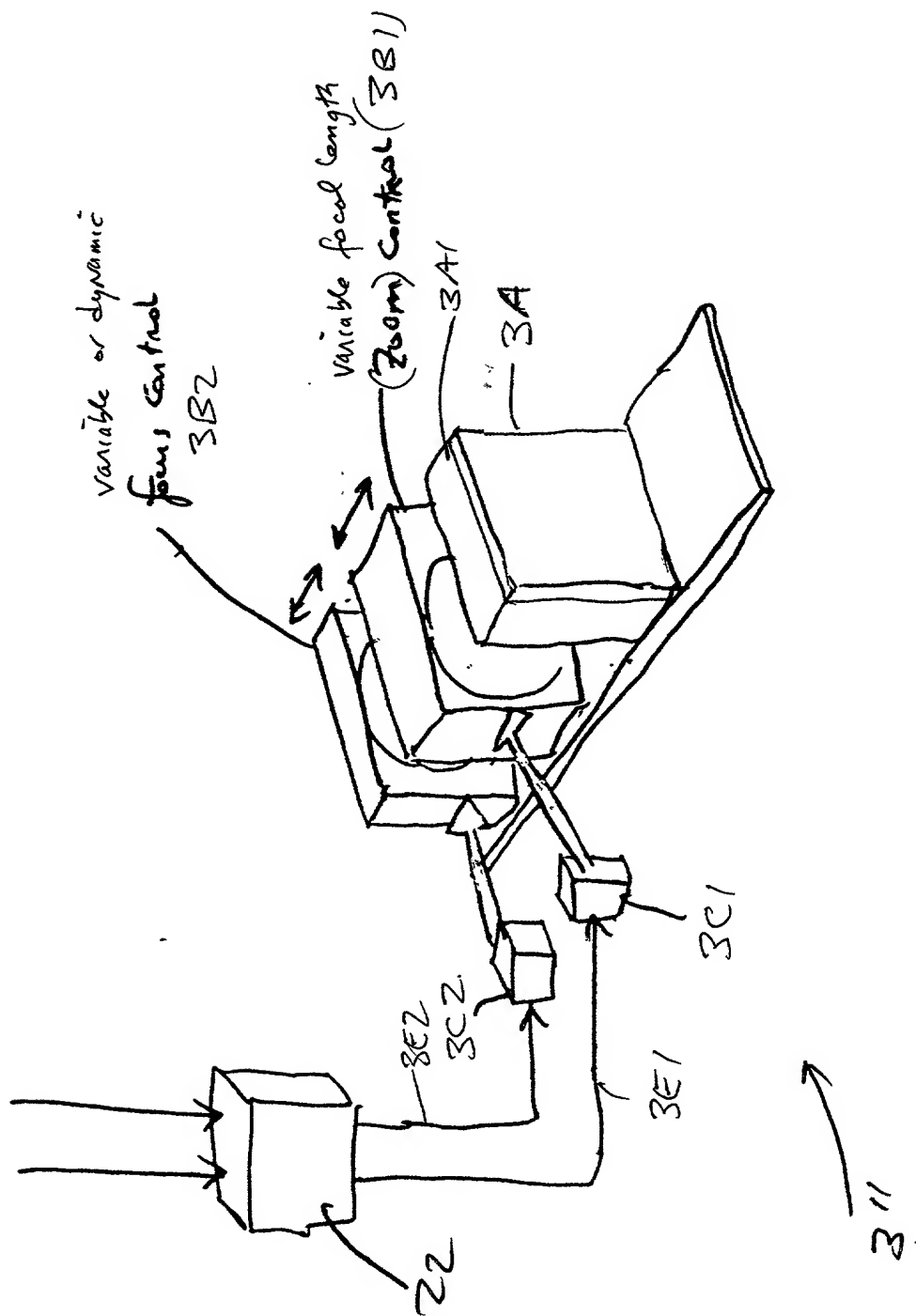


FIG. 3Q3

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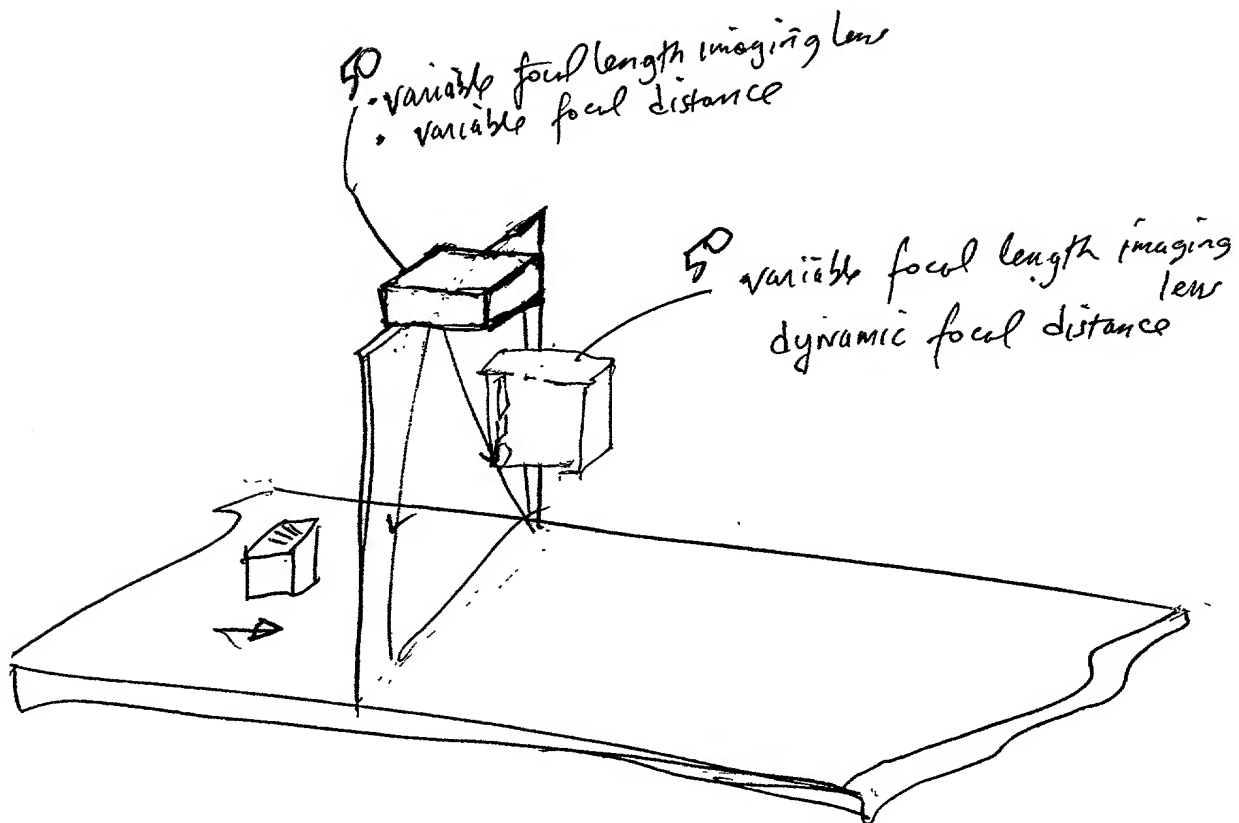


FIG. 3H

Composite
Plane of
Laser
Illumination

For Limits (10)

FIG. 31

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A hand-drawn perspective view of a rectangular device, possibly a control panel or a piece of equipment. The device is shown with various components and labels:

- 18**: Points to the top surface of the device.
- 19**: Points to the front edge of the device.
- 20**: Points to the left side of the device.
- 21**: Points to the bottom edge of the device.
- 22**: Points to a central component on the top surface.
- 299**: Points to a component on the right side of the top surface.
- 37A**: Points to a component on the right side of the top surface.
- 37B**: Points to a component on the right side of the top surface.
- 3A**: Points to a component on the right side of the top surface.
- 3B**: Points to a component on the right side of the top surface.
- 6A**: Points to a component on the right side of the top surface.
- 6B**: Points to a component on the right side of the top surface.

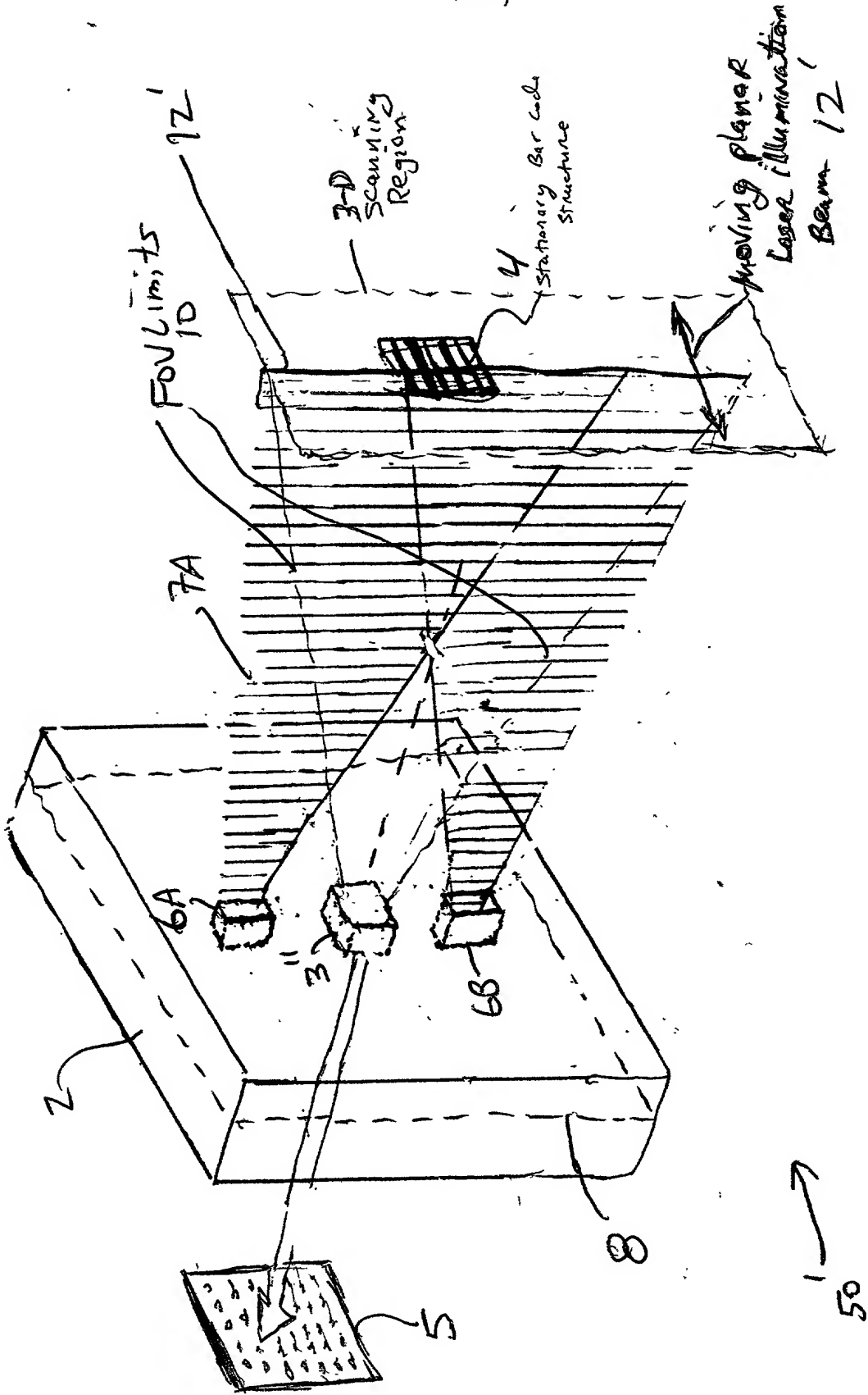


FIG. 3J1

15b/332

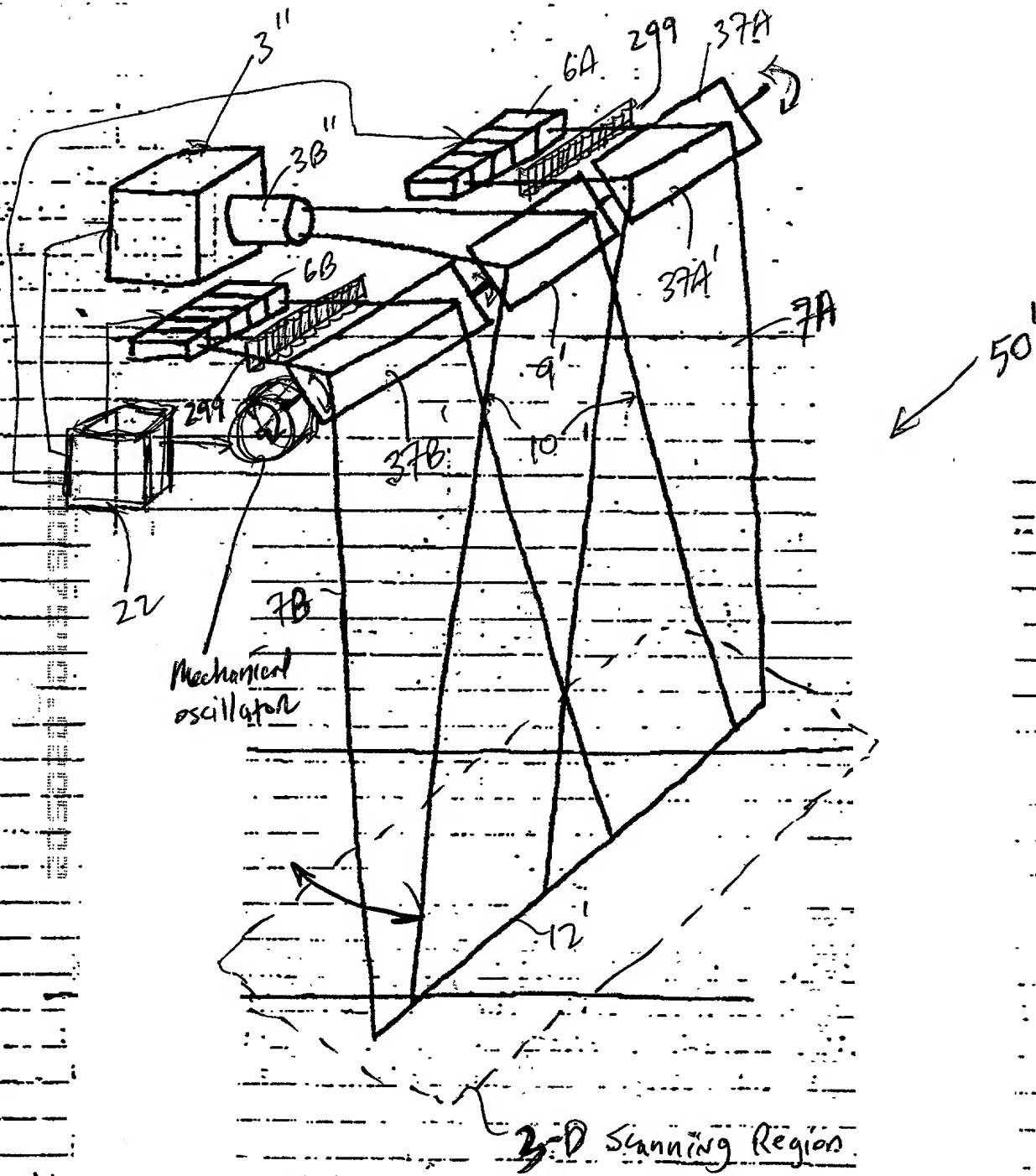


FIG 3J2

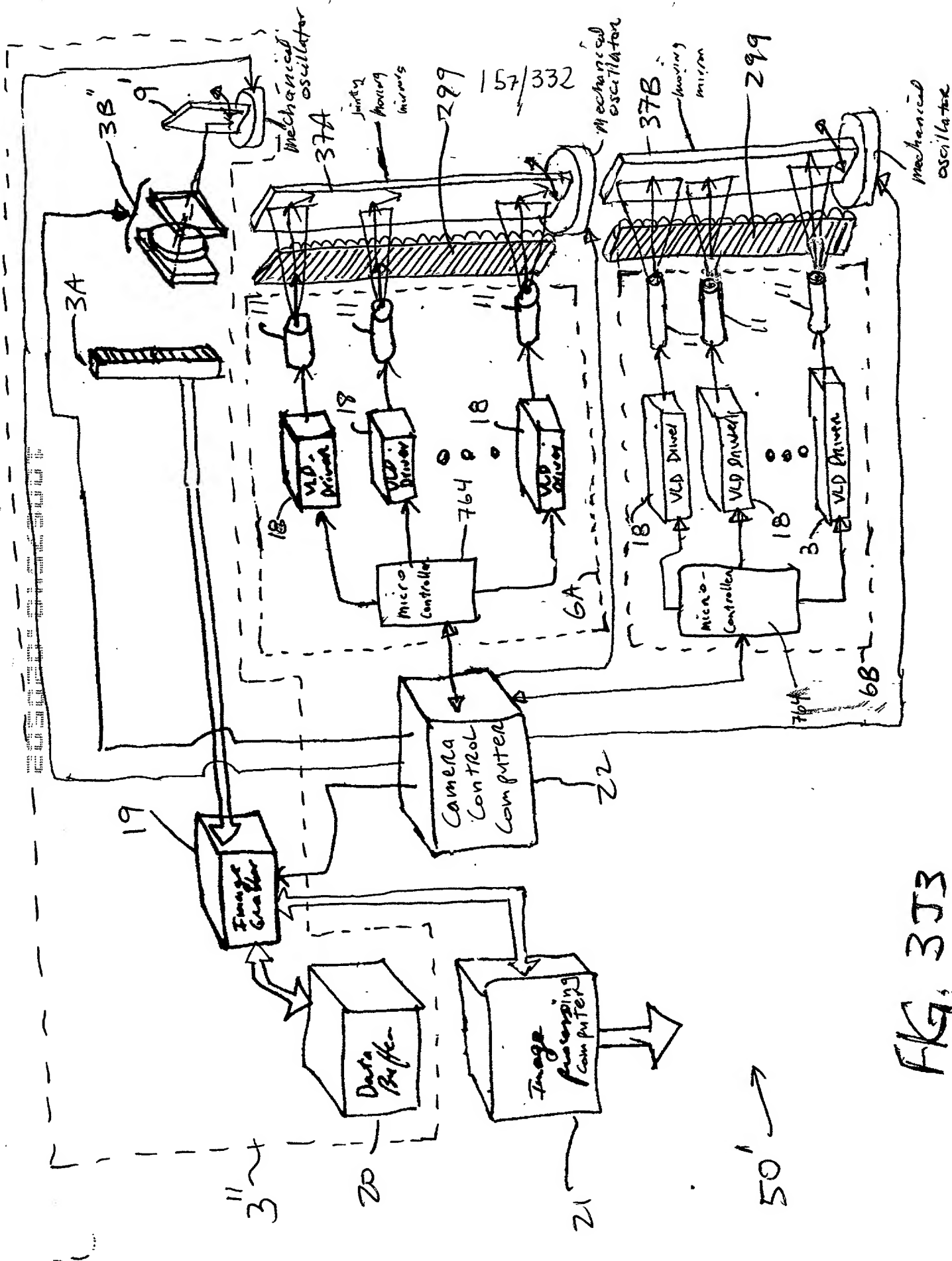


FIG. 3J3

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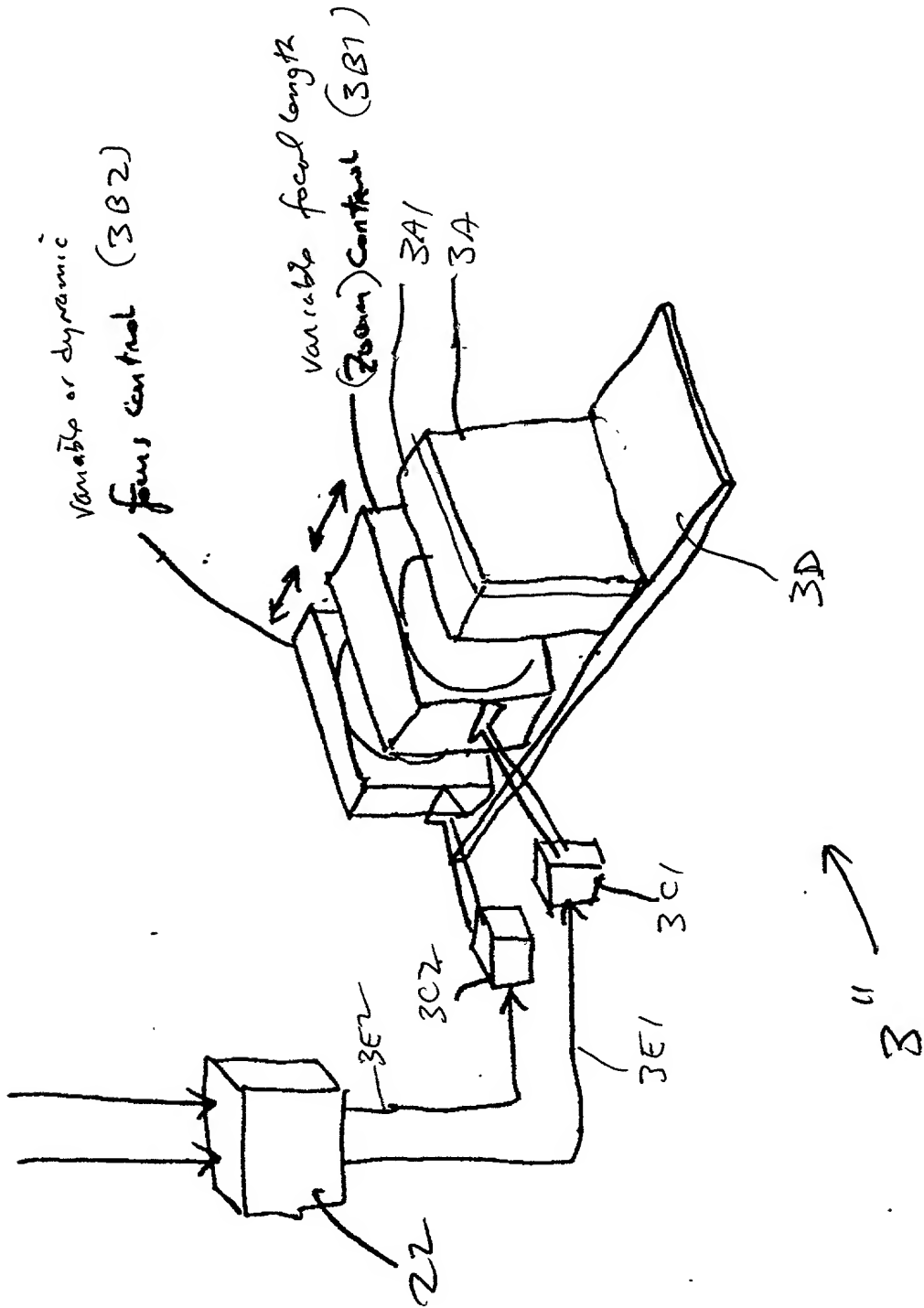


FIG. 354

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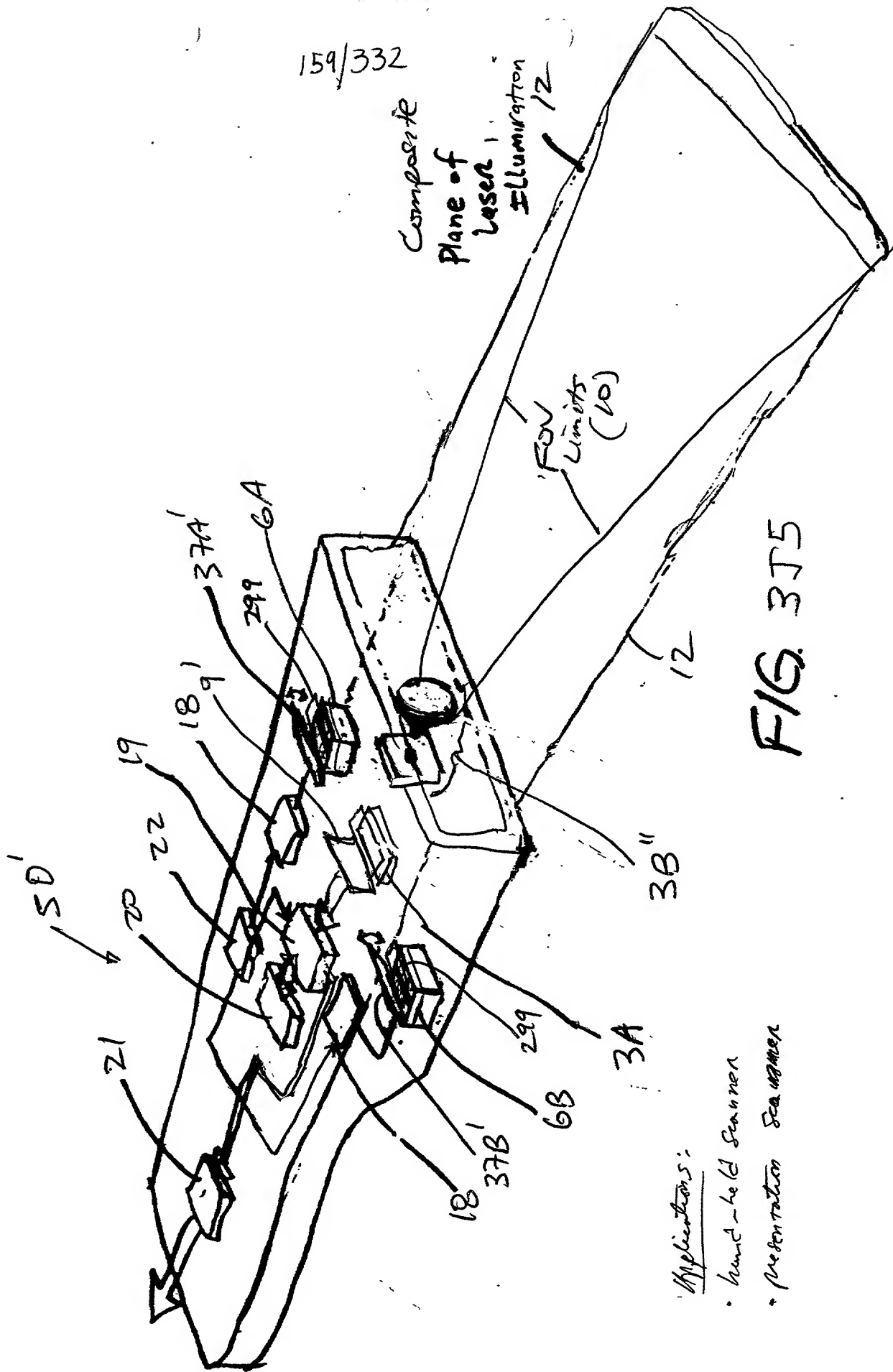
Composite
Plane of
Laser
Illumination

For Limits (10)

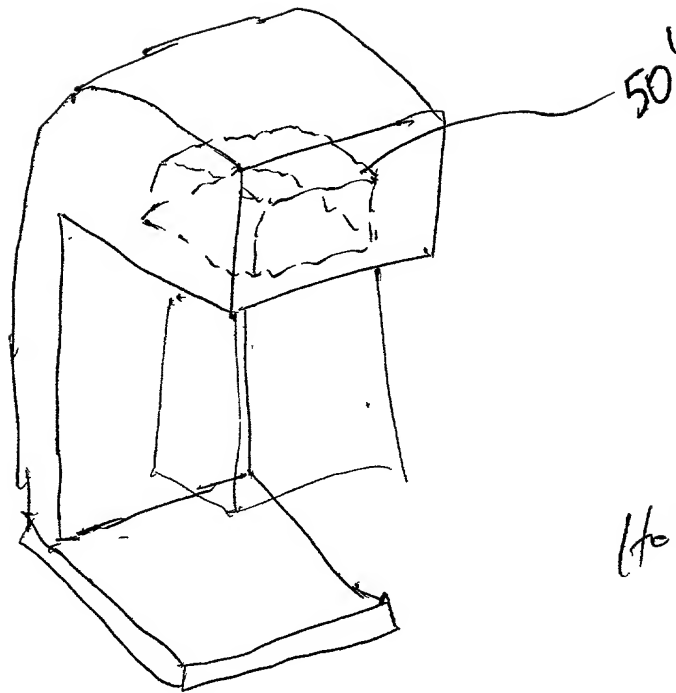
FIG. 3T5

Applications:

- hand-held scanner
- presentation scanner



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2-D
Hold-un der
Scanner

FIG. 316

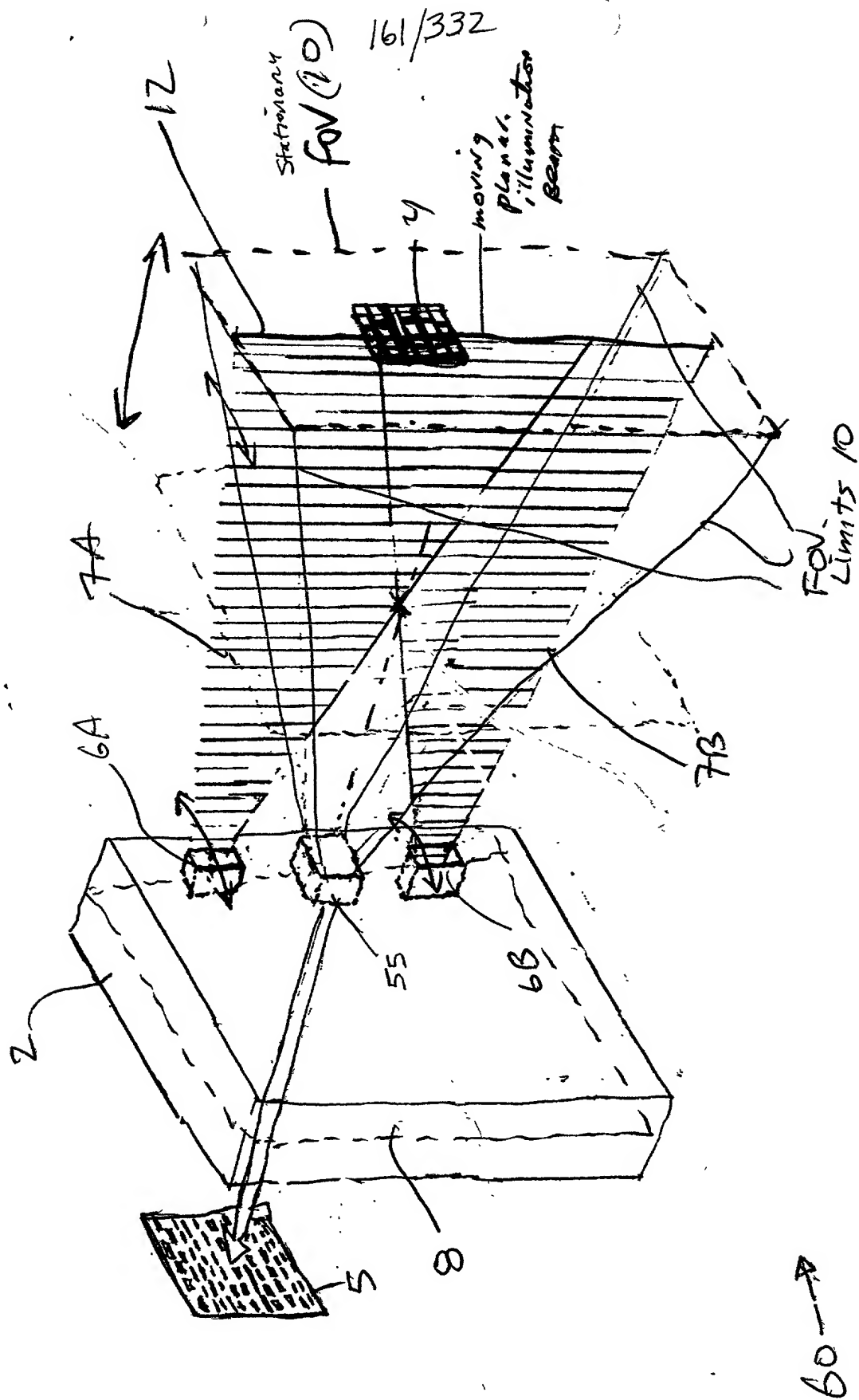


FIG 4A

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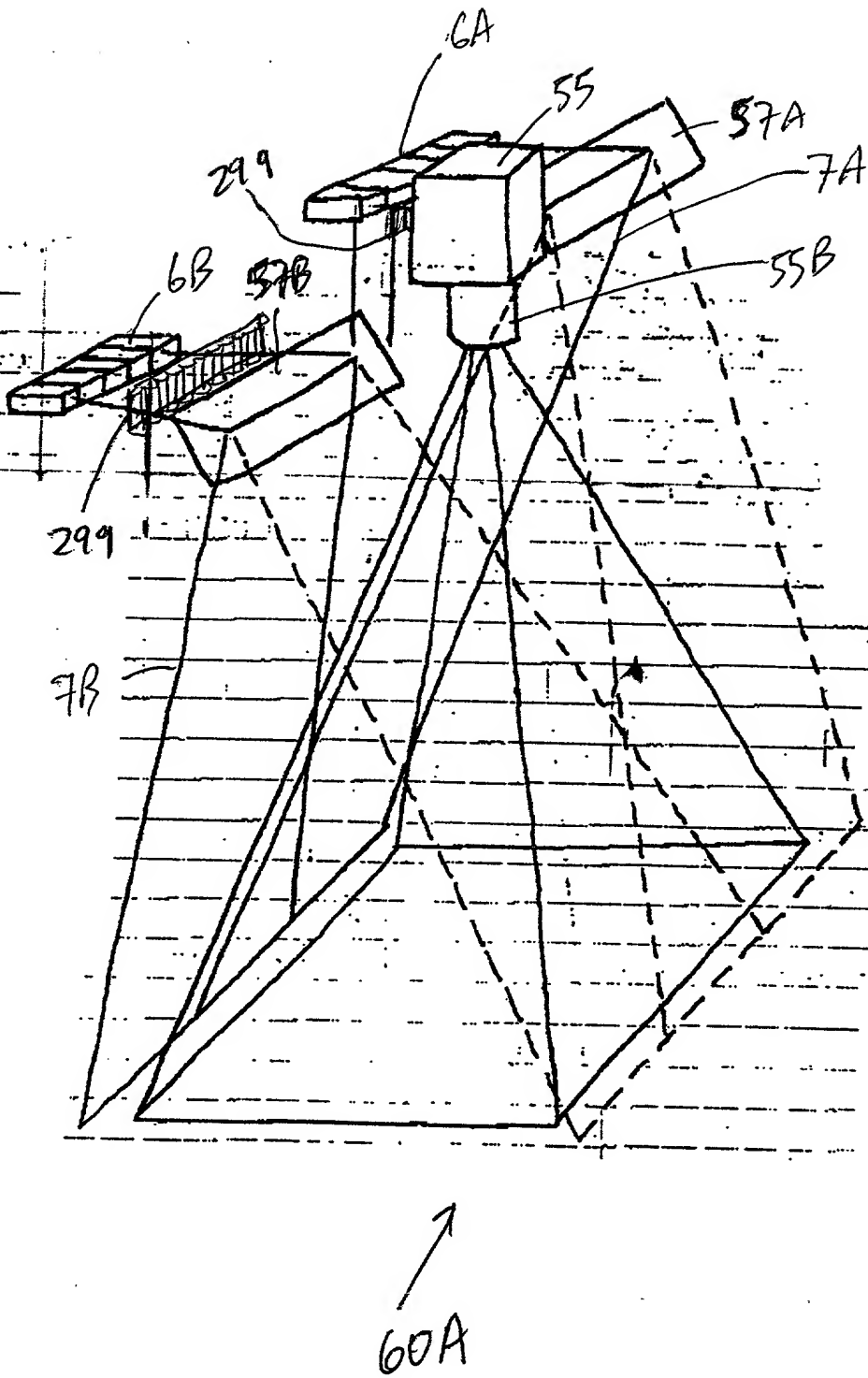


FIG. 4B1

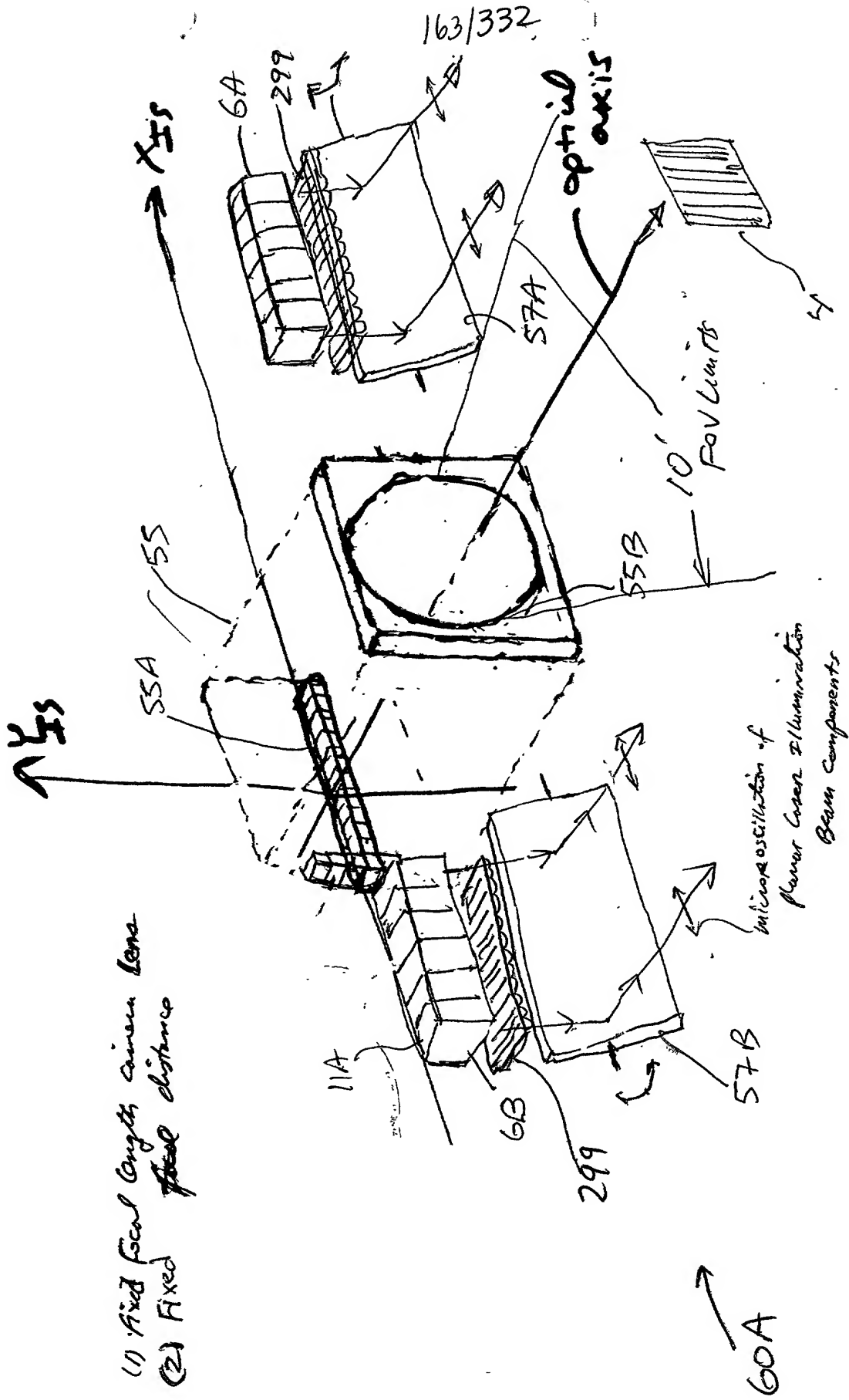


FIG. 4B.2

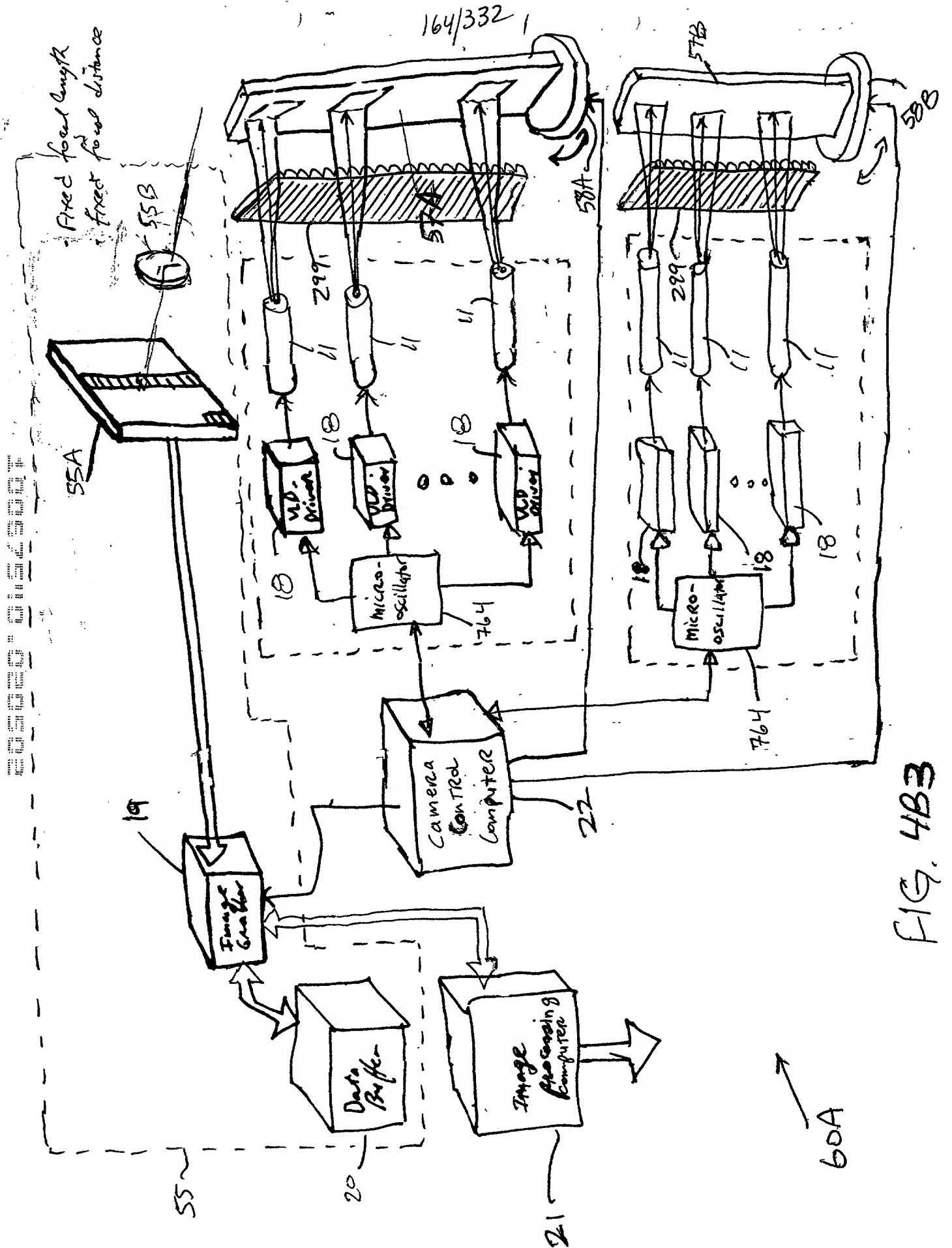


FIG. 4B3

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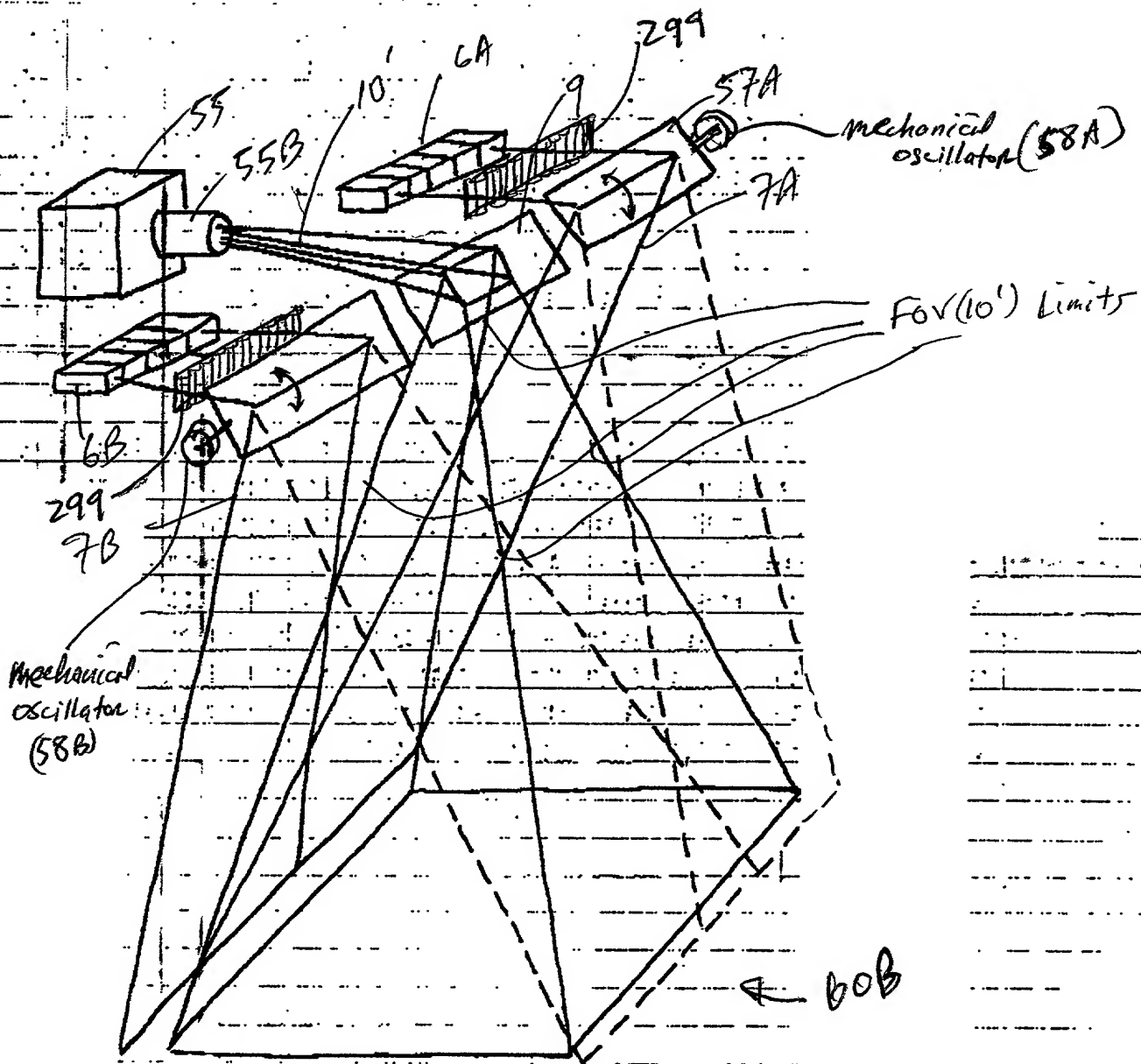


FIG. 4C1

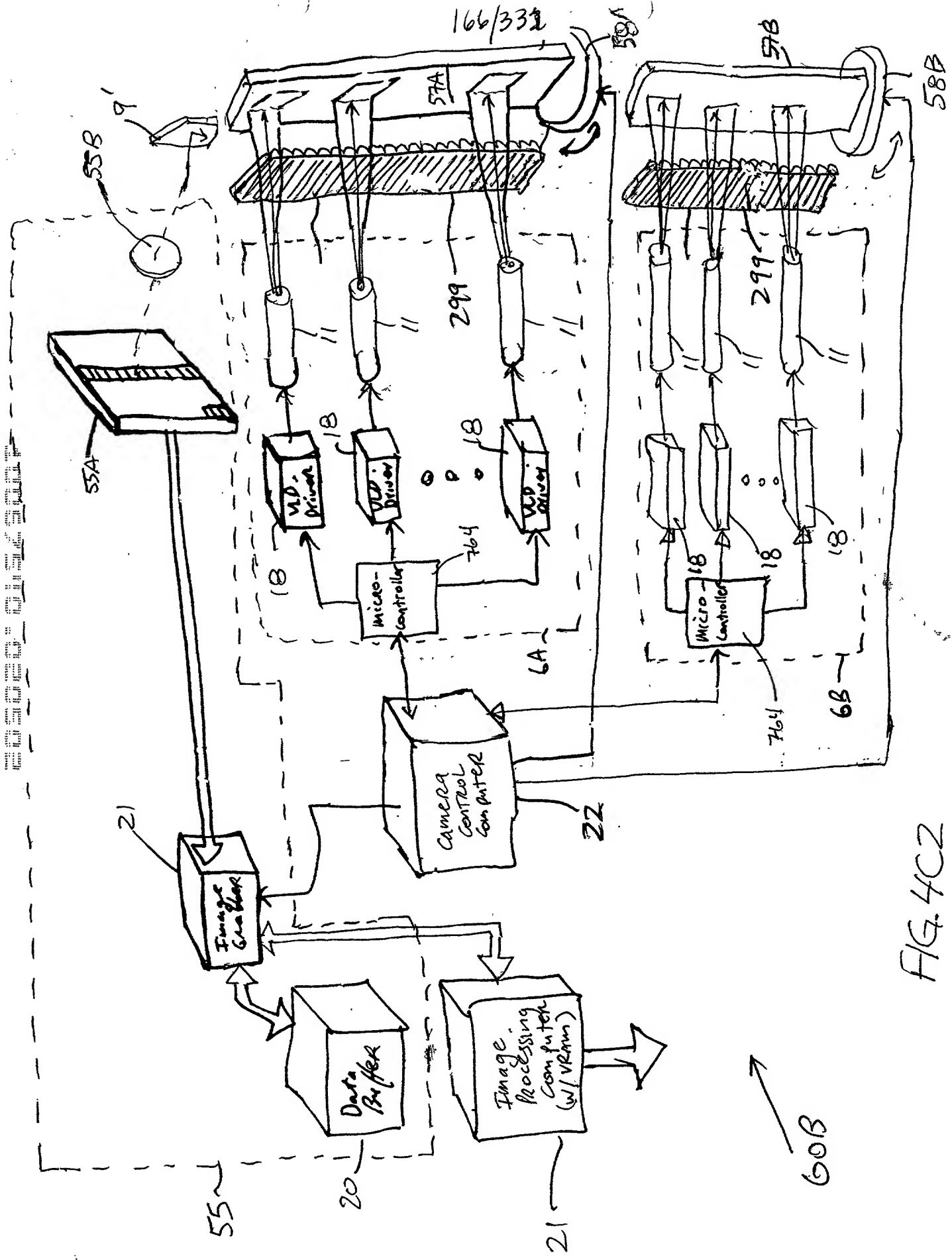


FIG. 4C2

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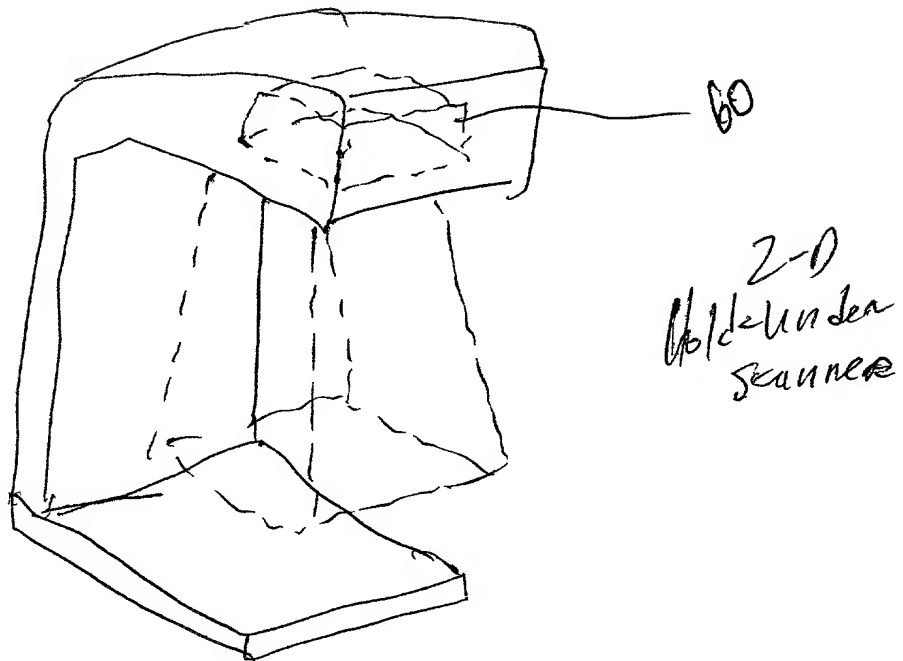


FIG. 4D

168/332
Plane of
laser
illumination

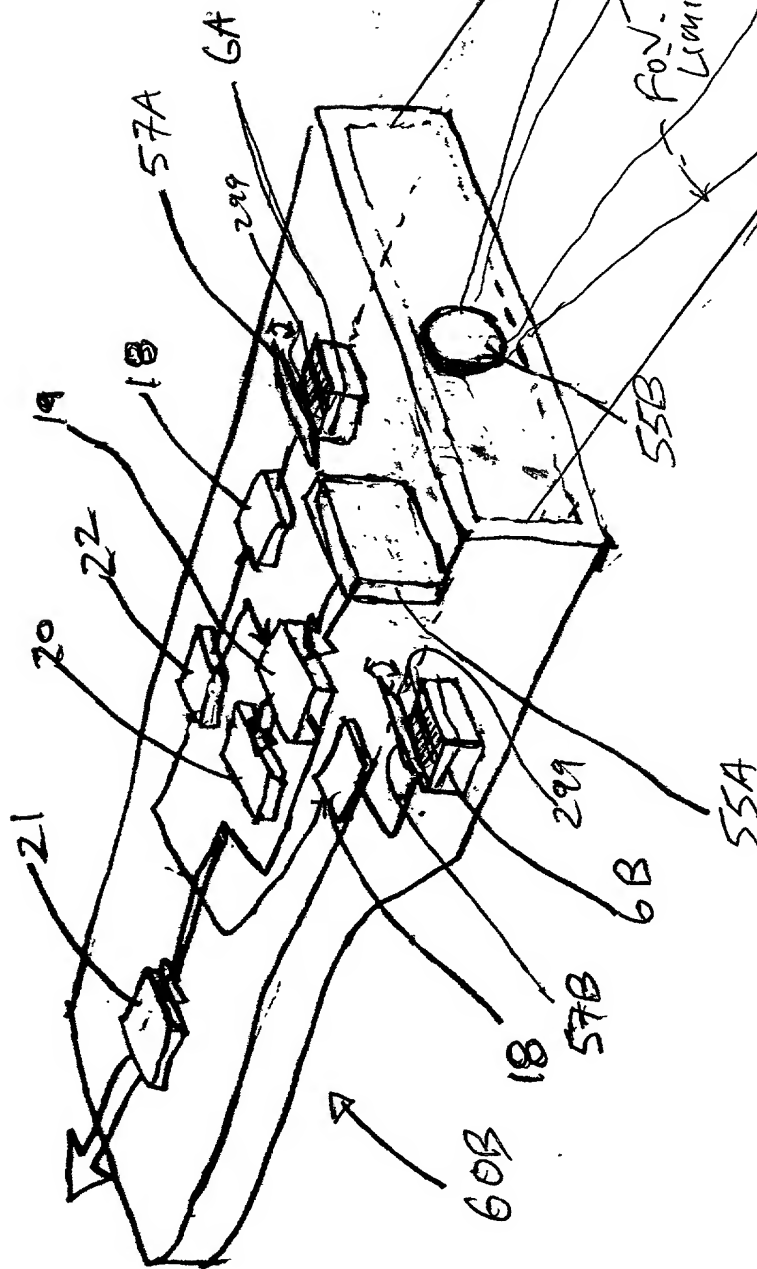
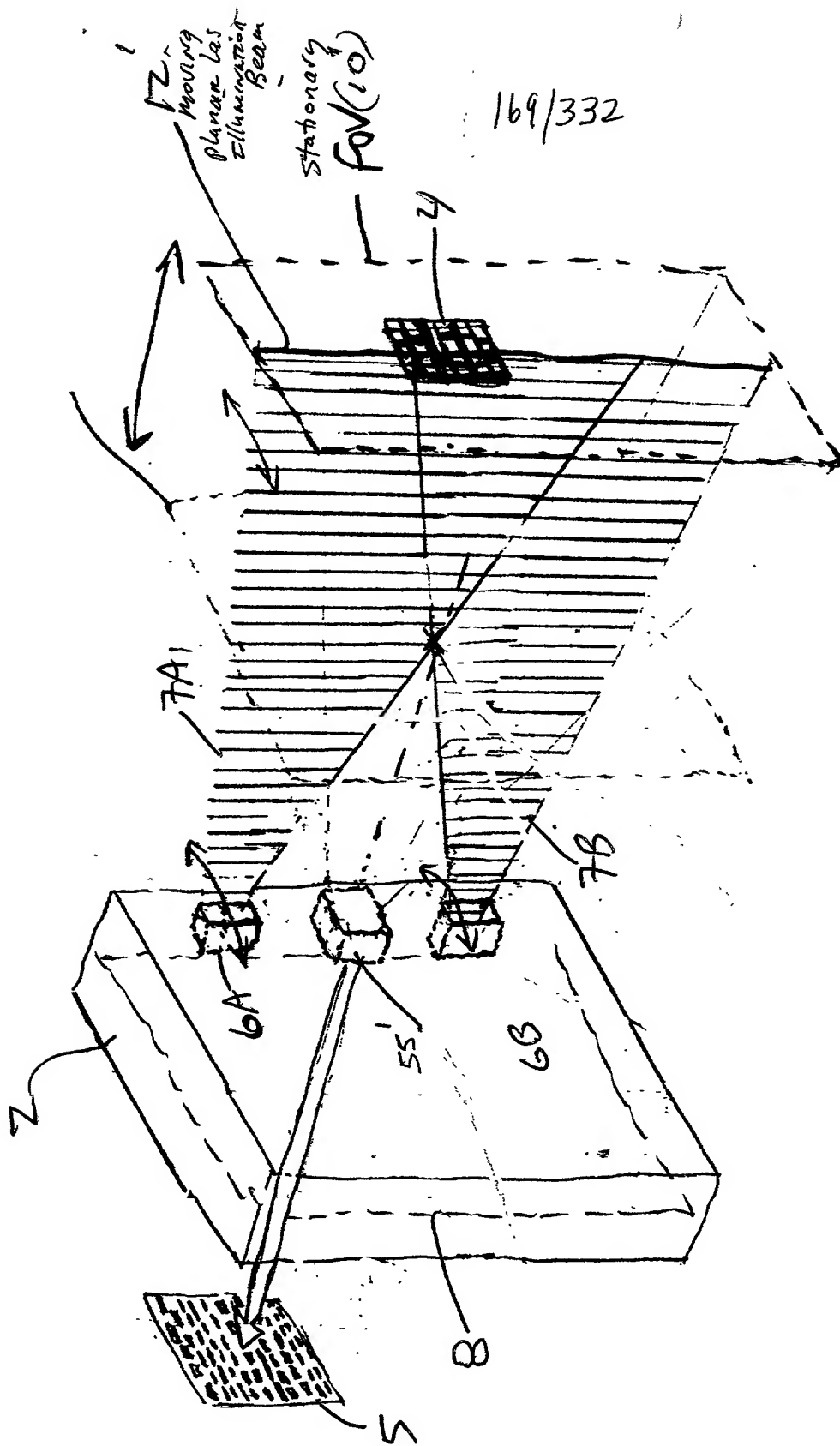


FIG. 4E

Applications:

- Hand-held Scanner
- Presentation Scanner



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FIG 5A

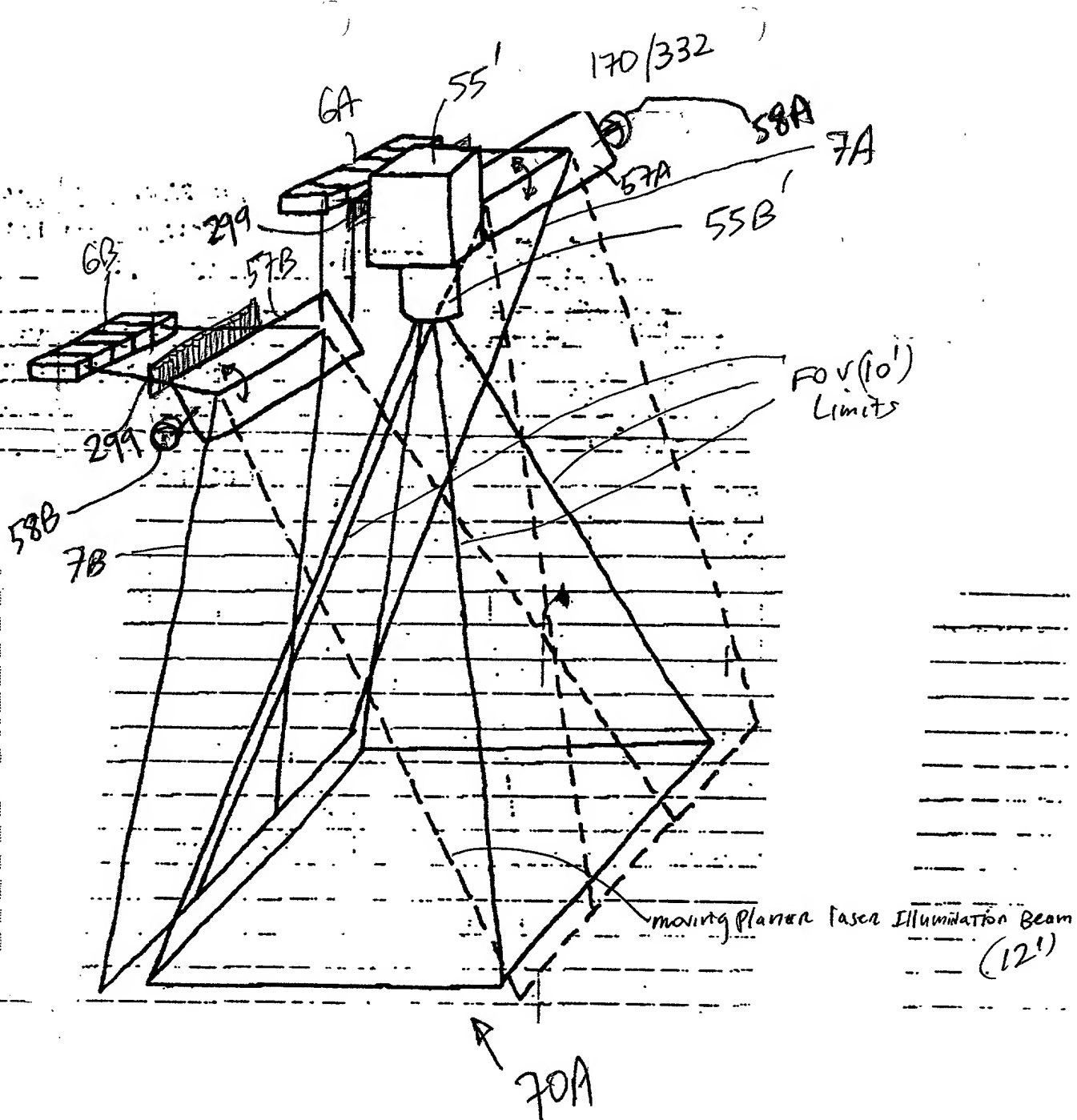


FIG 5B1

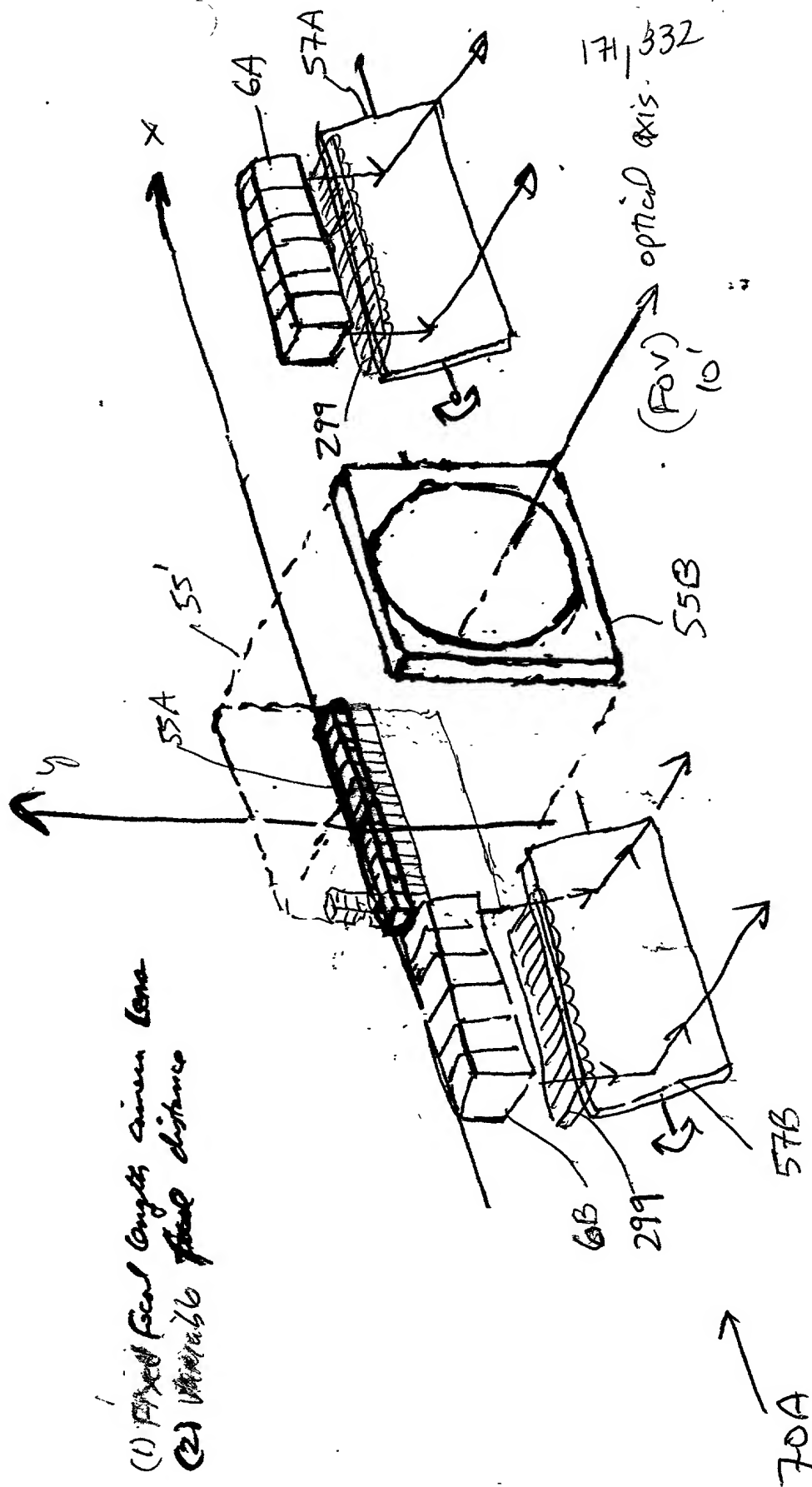


FIG. 5B2

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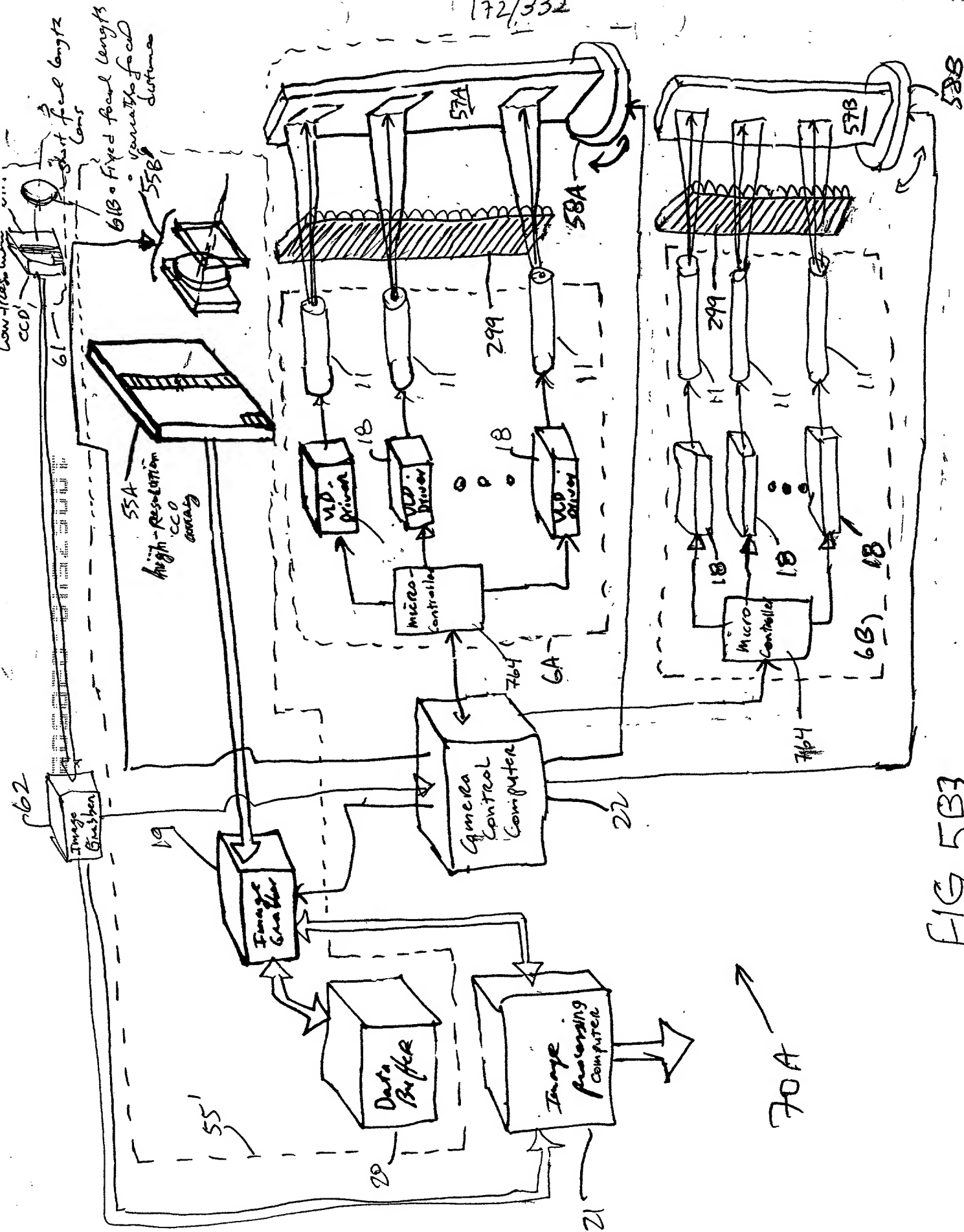


FIG. 5B3

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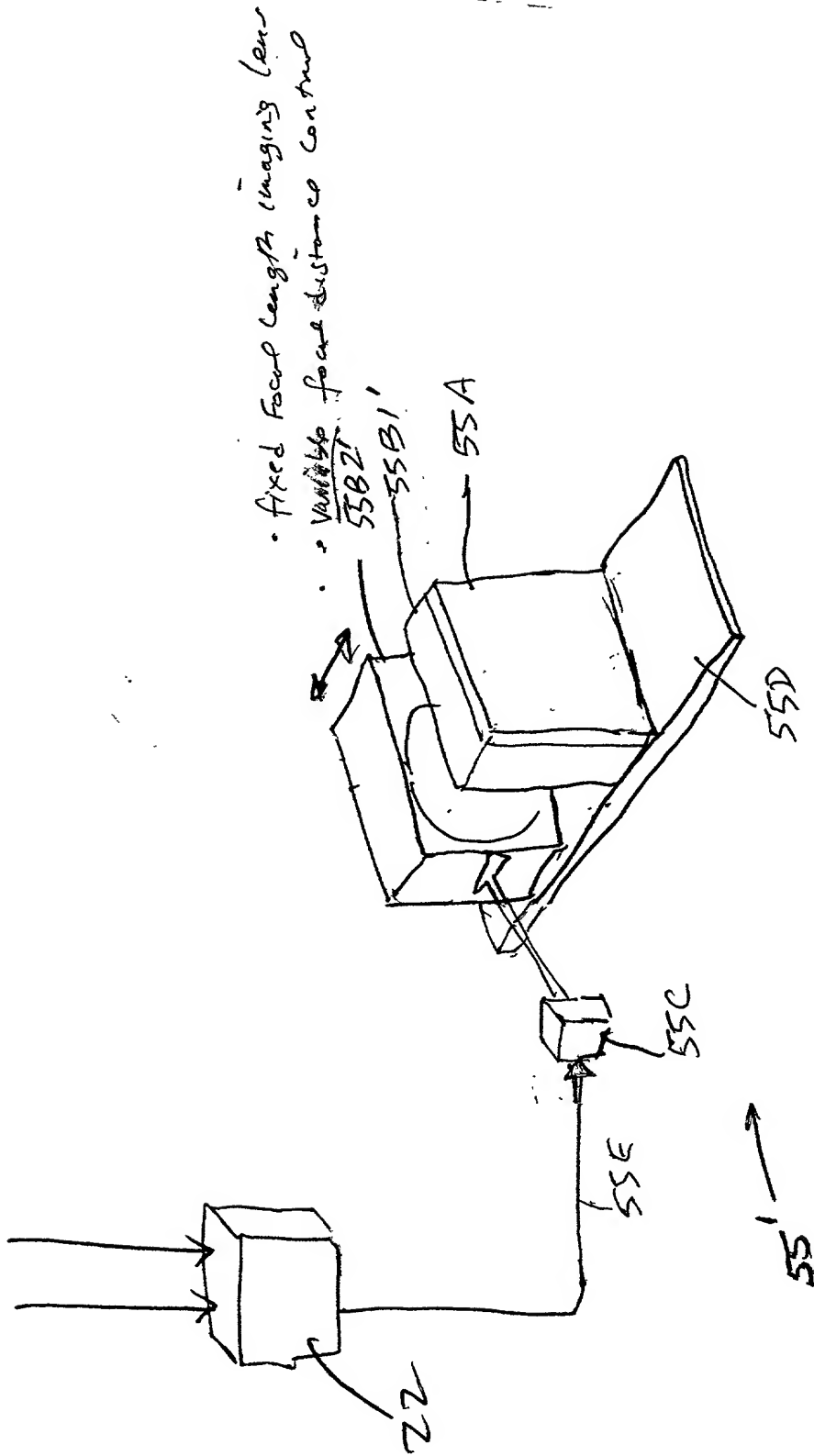


FIG. 5B4

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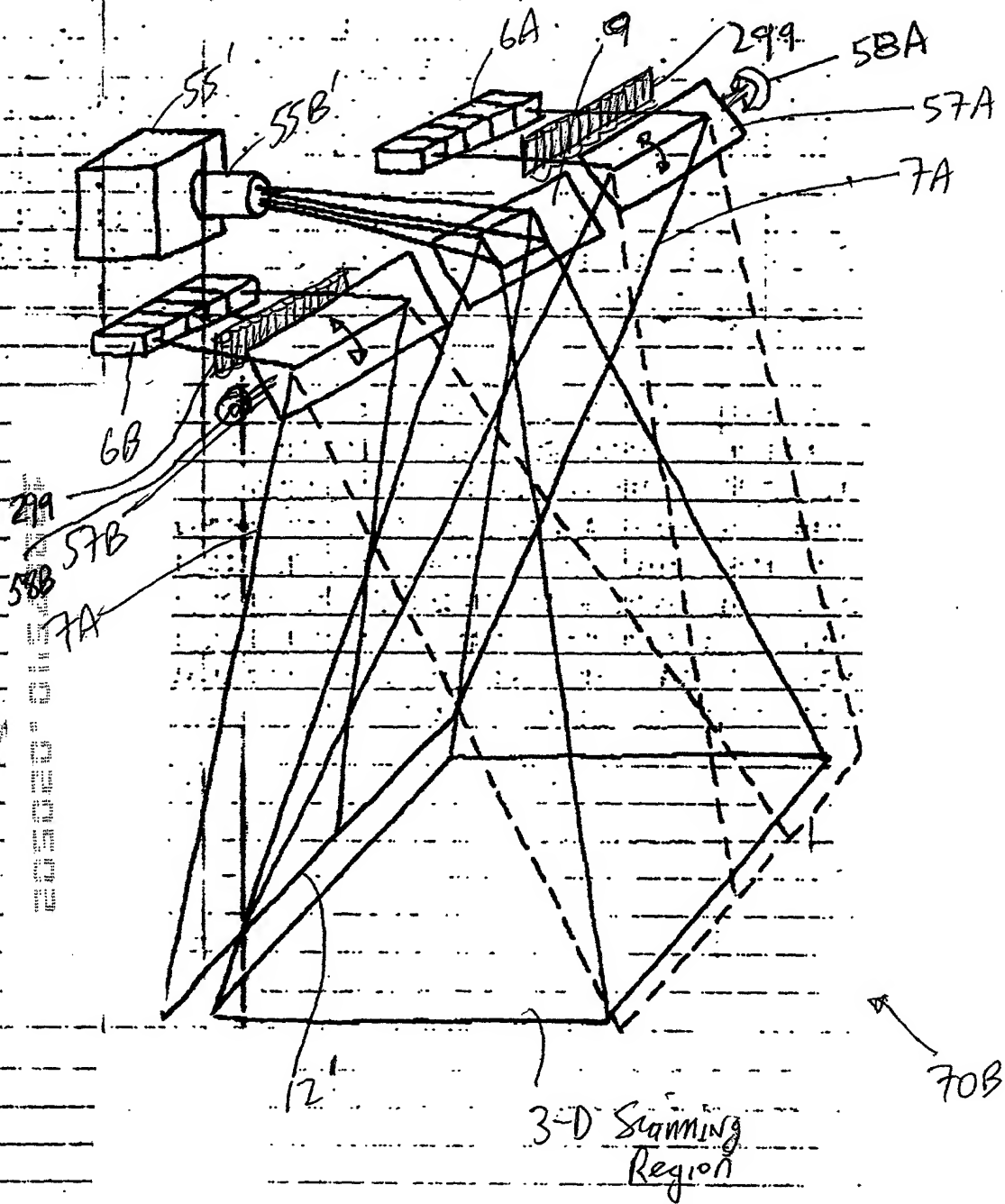
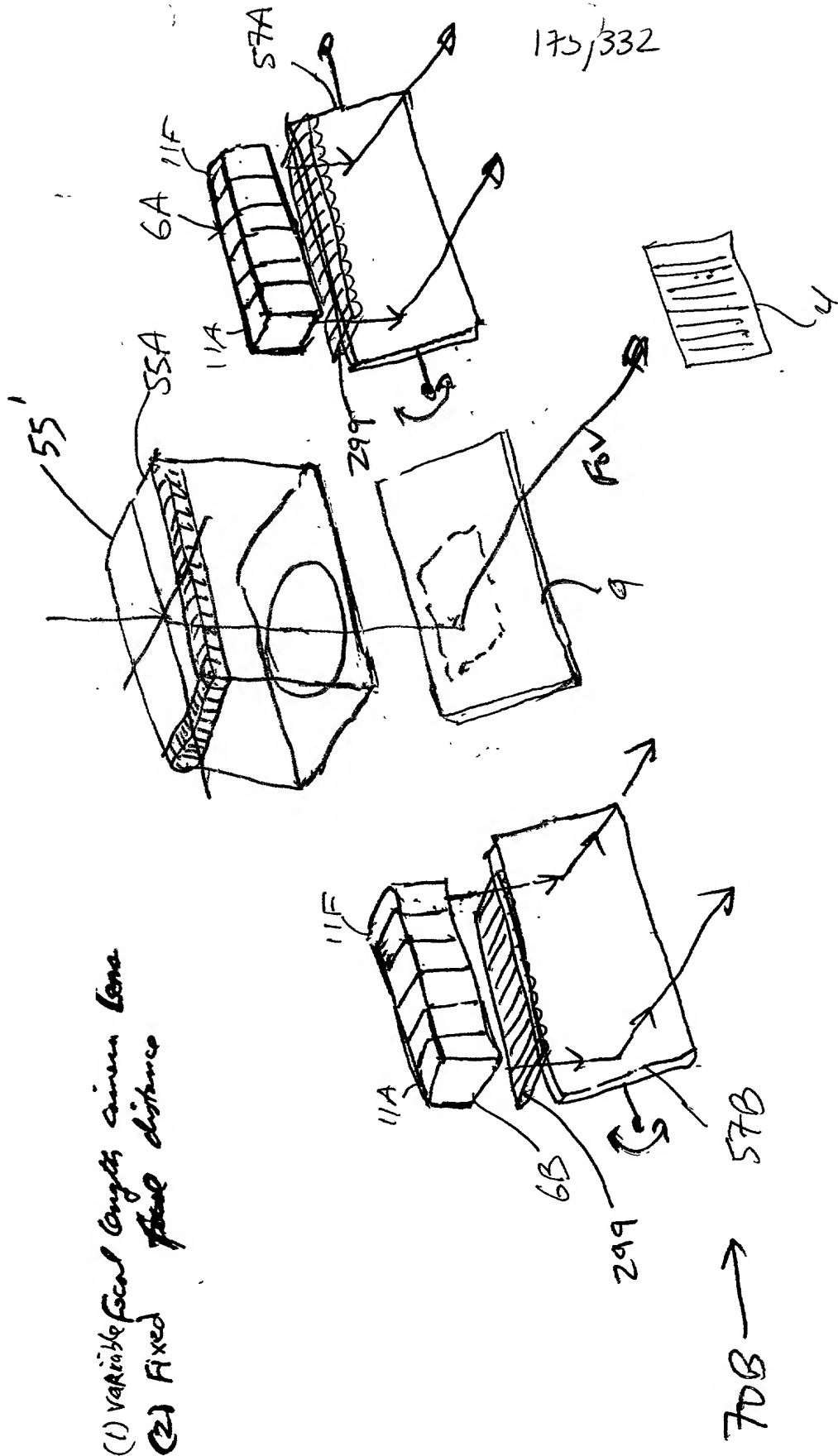


FIG. 5C1



- (1) Variable focal length lens
- (2) Fixed distance

FIG. 5C

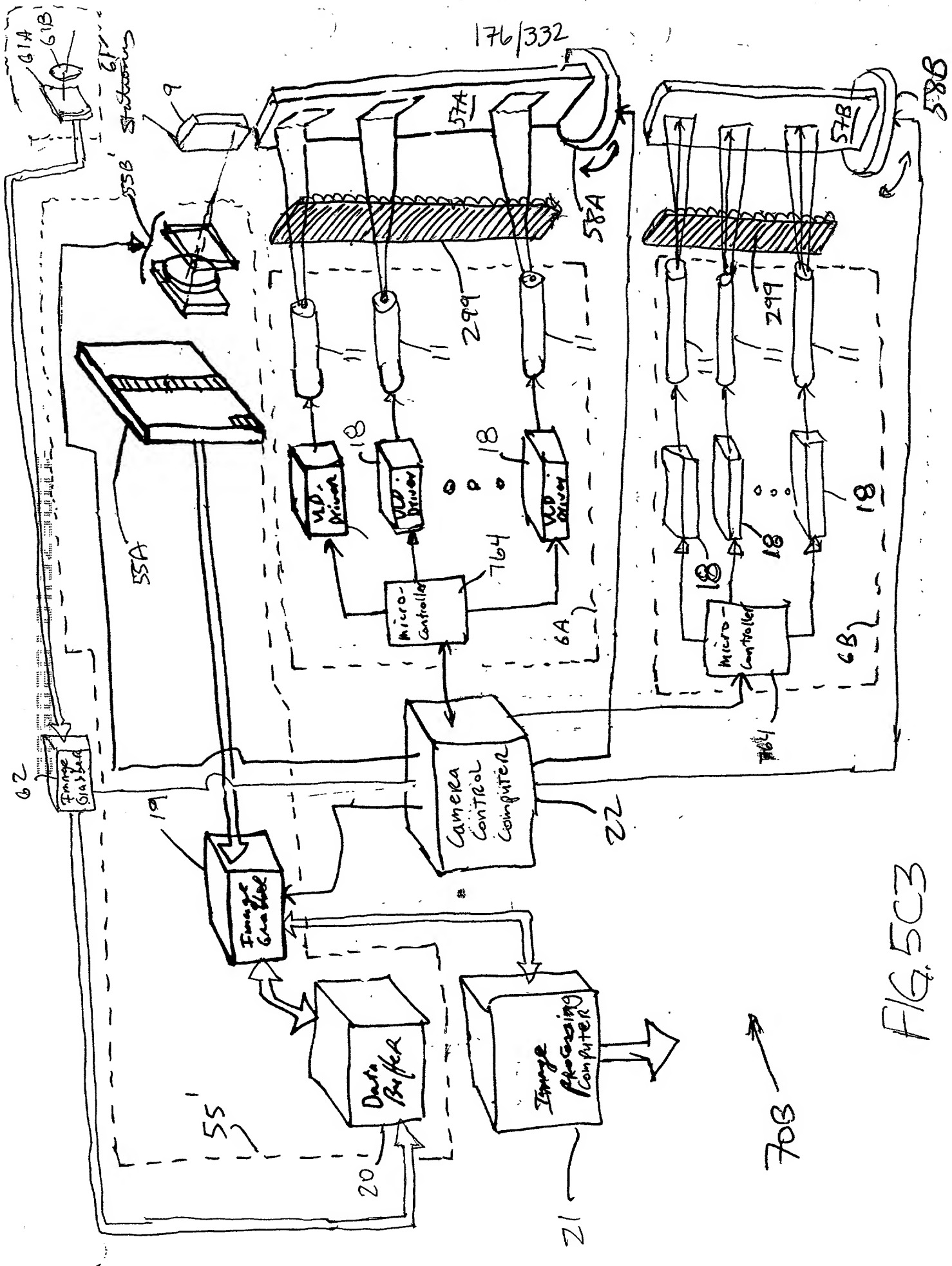


FIG. 5C3

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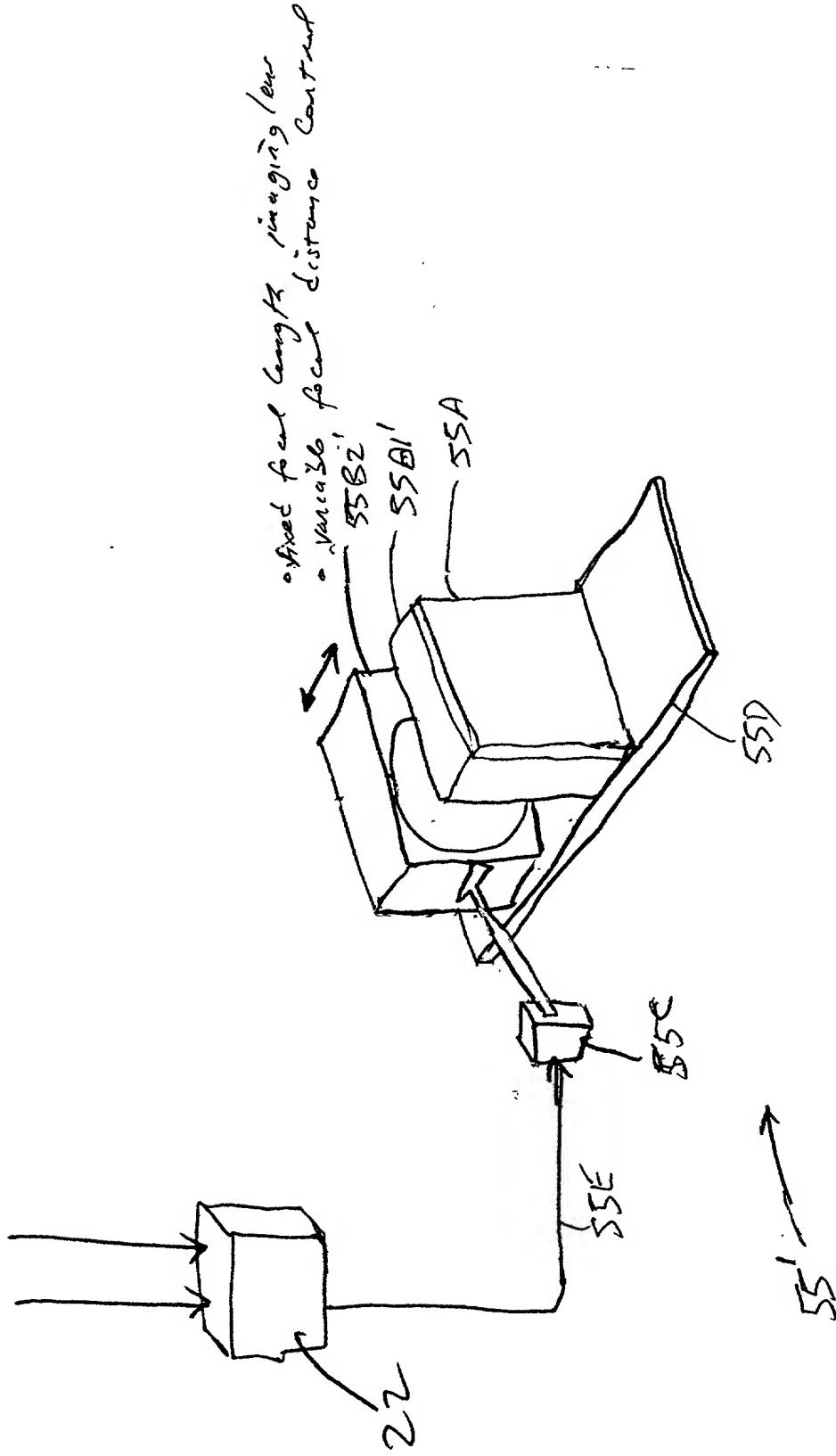


FIG. 5C4

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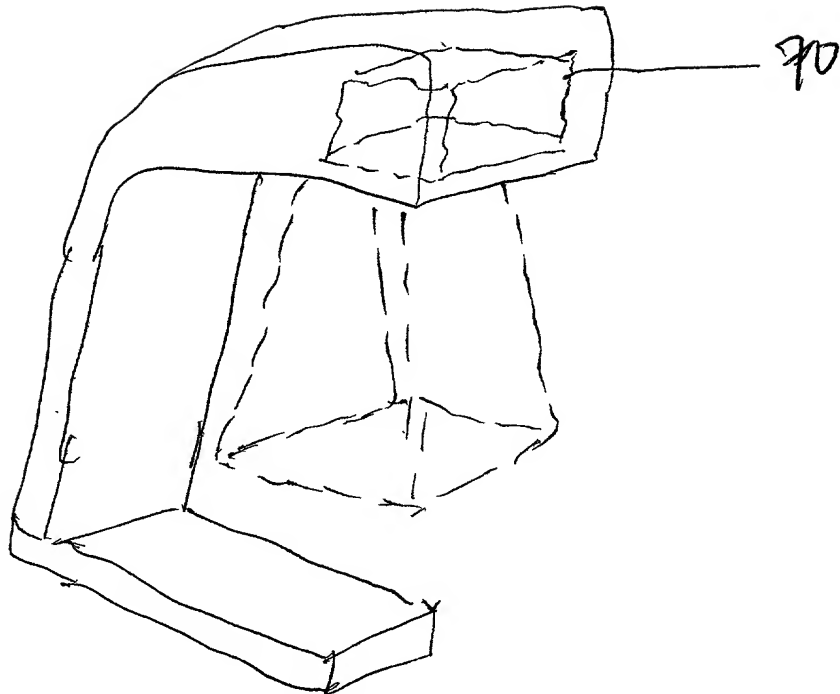


FIG. 5D

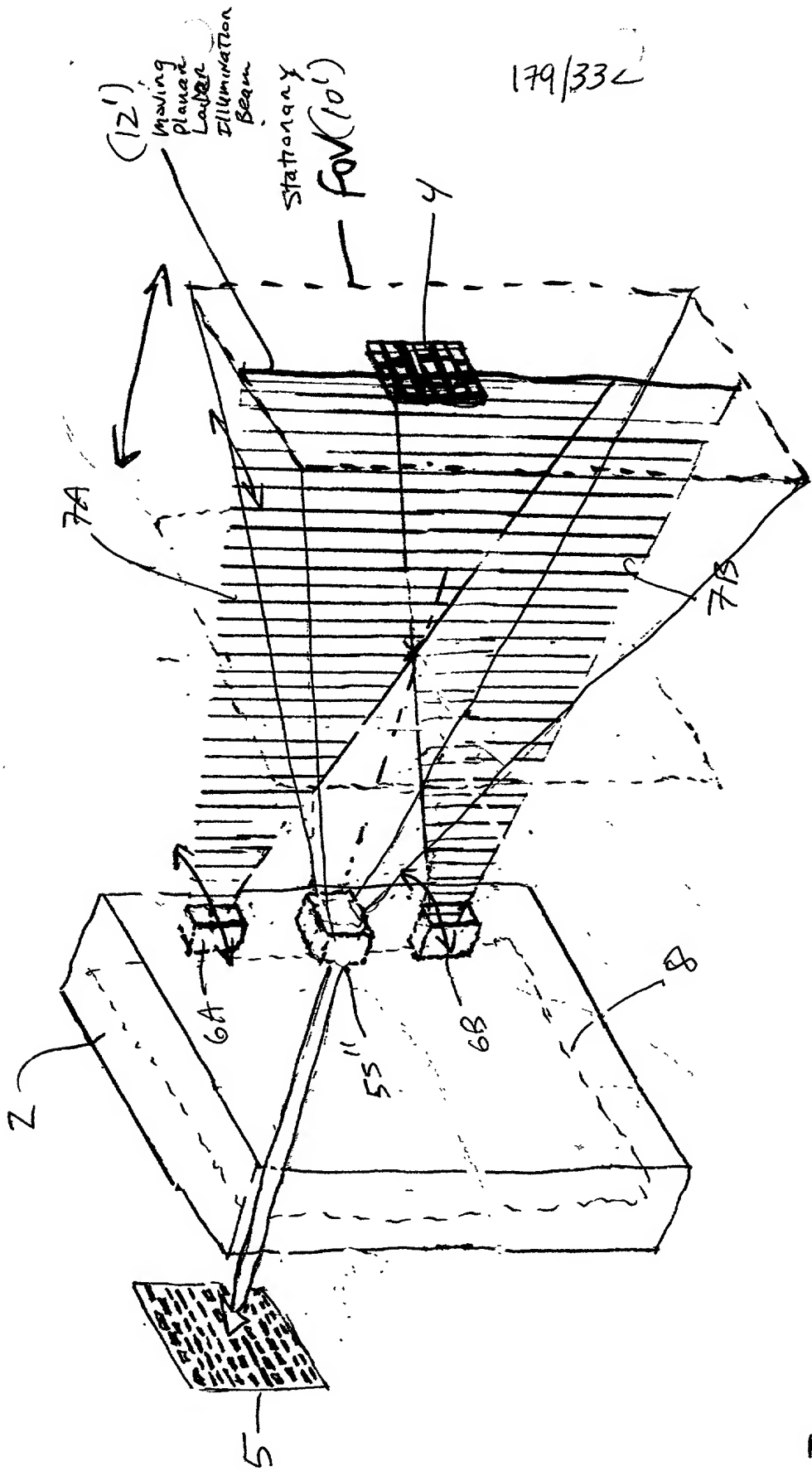


FIG. 6A

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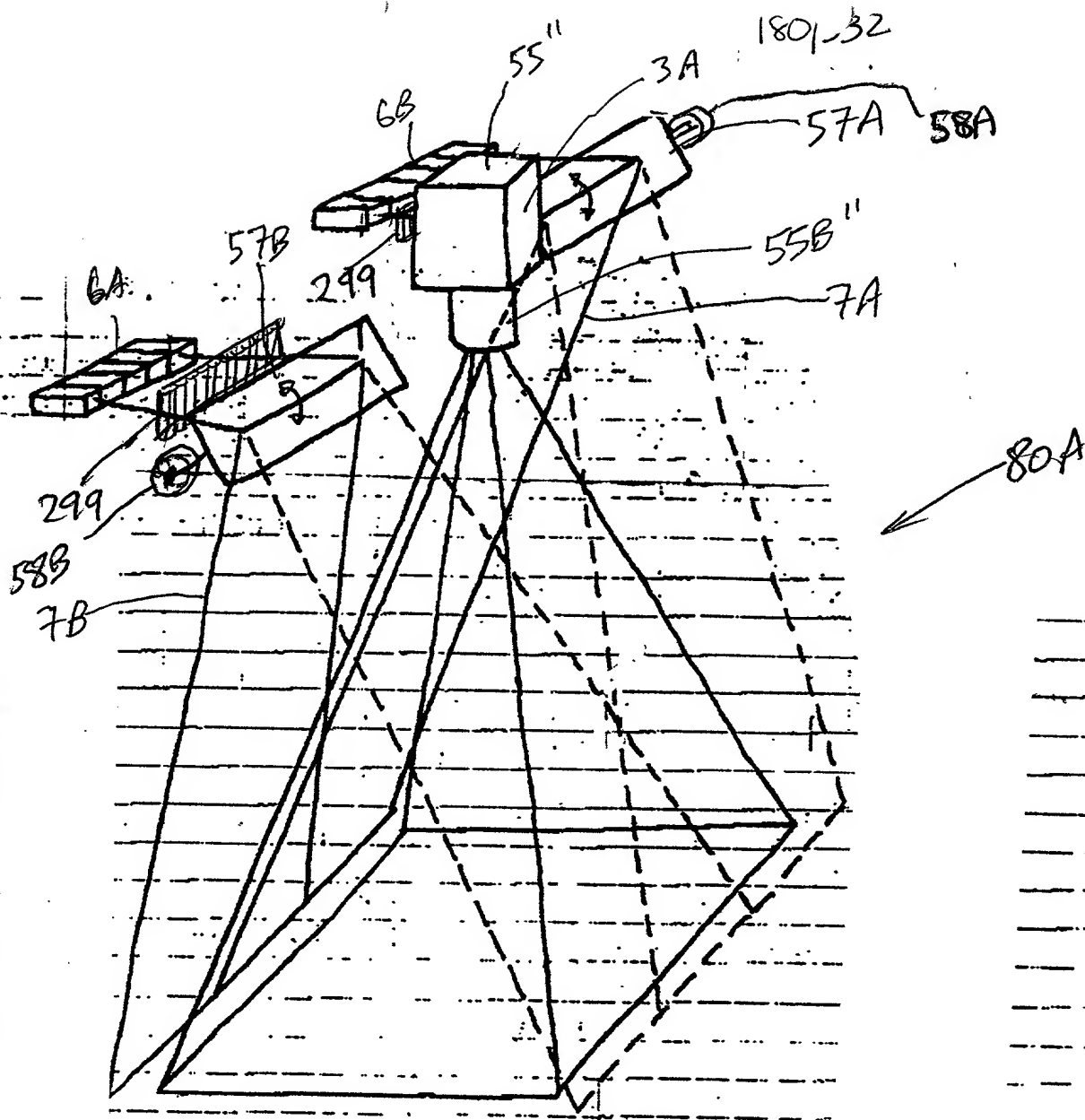


FIG. 6B1

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FIG. 6B2

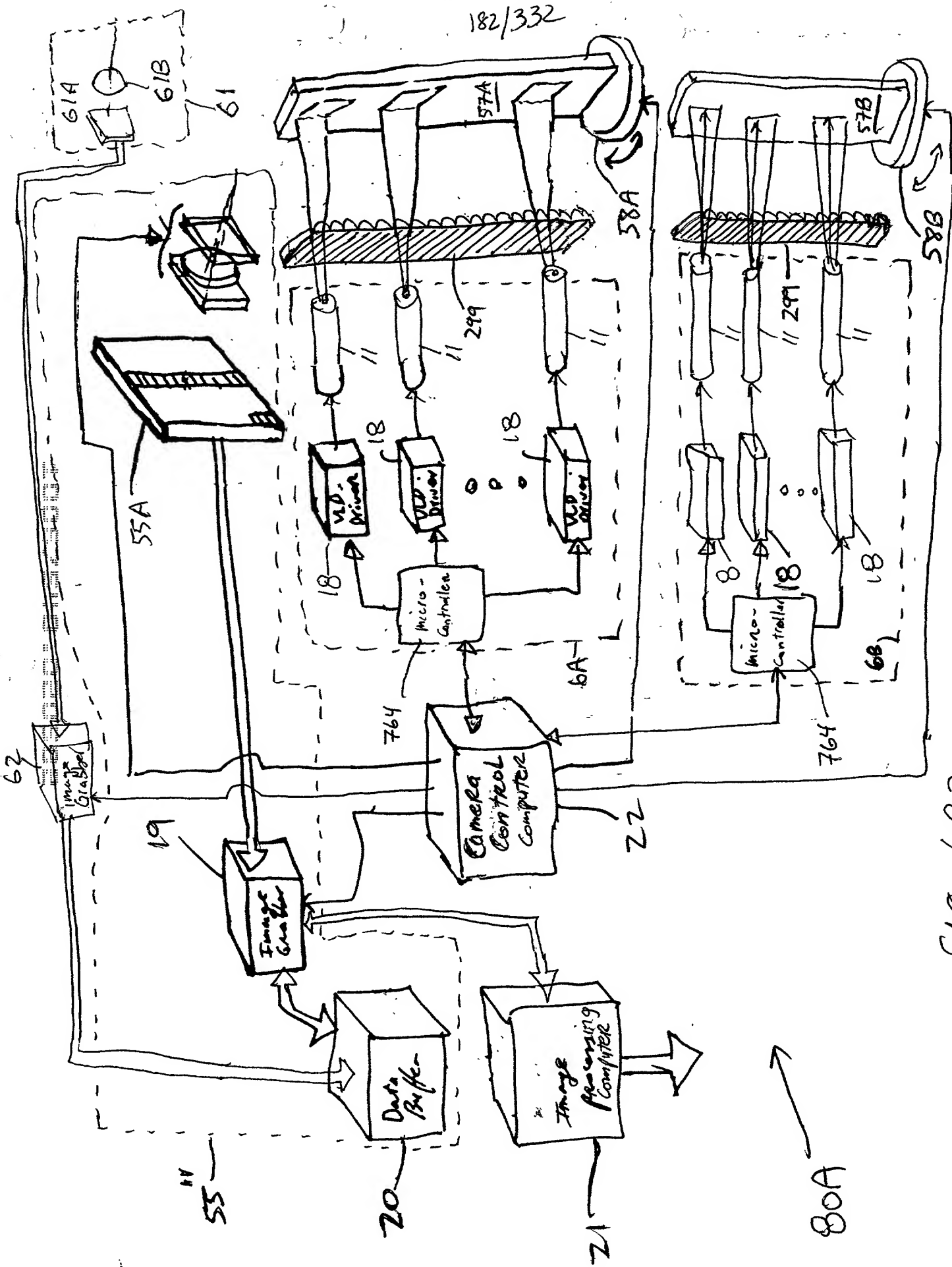


FIG. 6B3

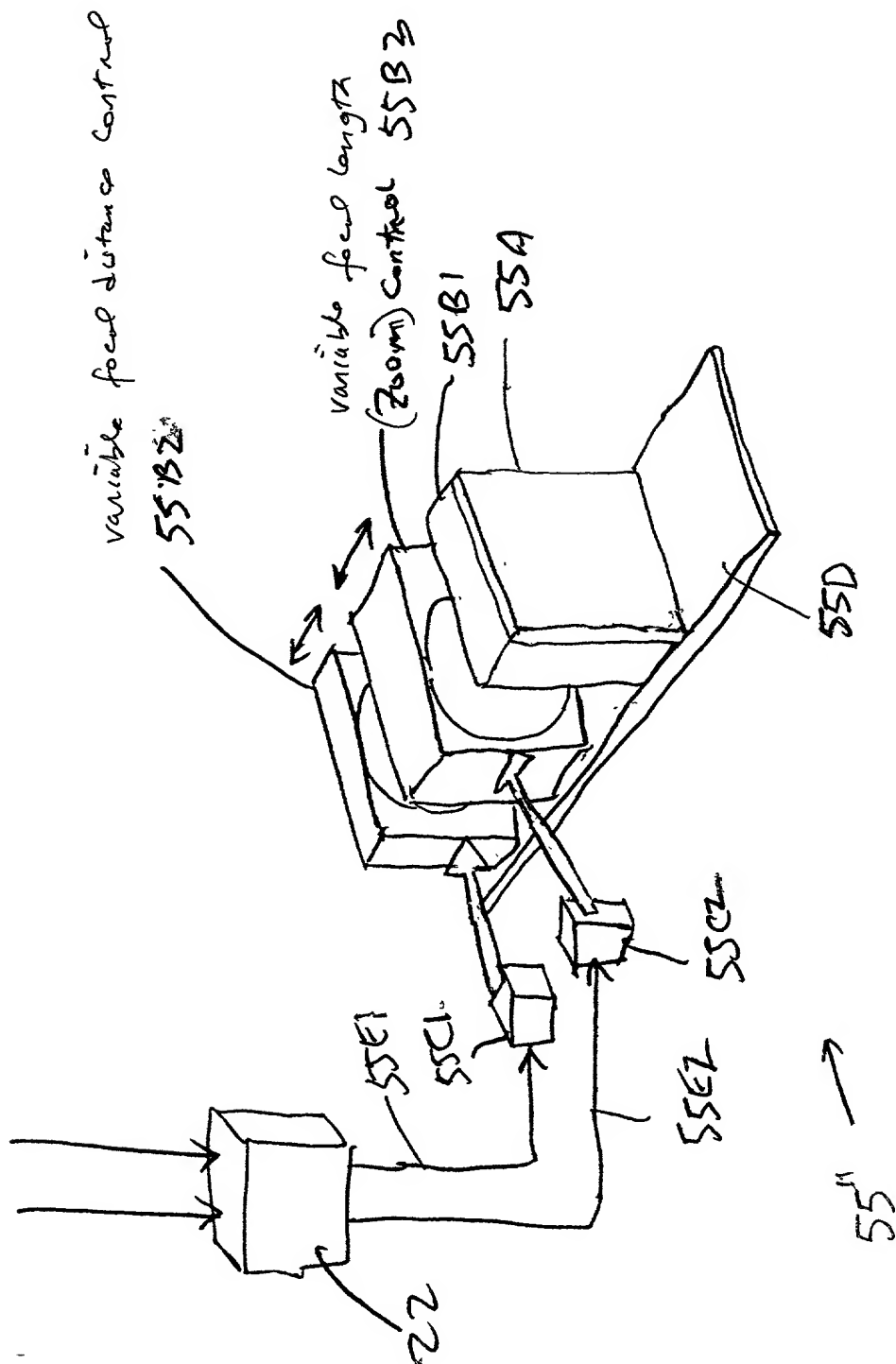


FIG. 6B4

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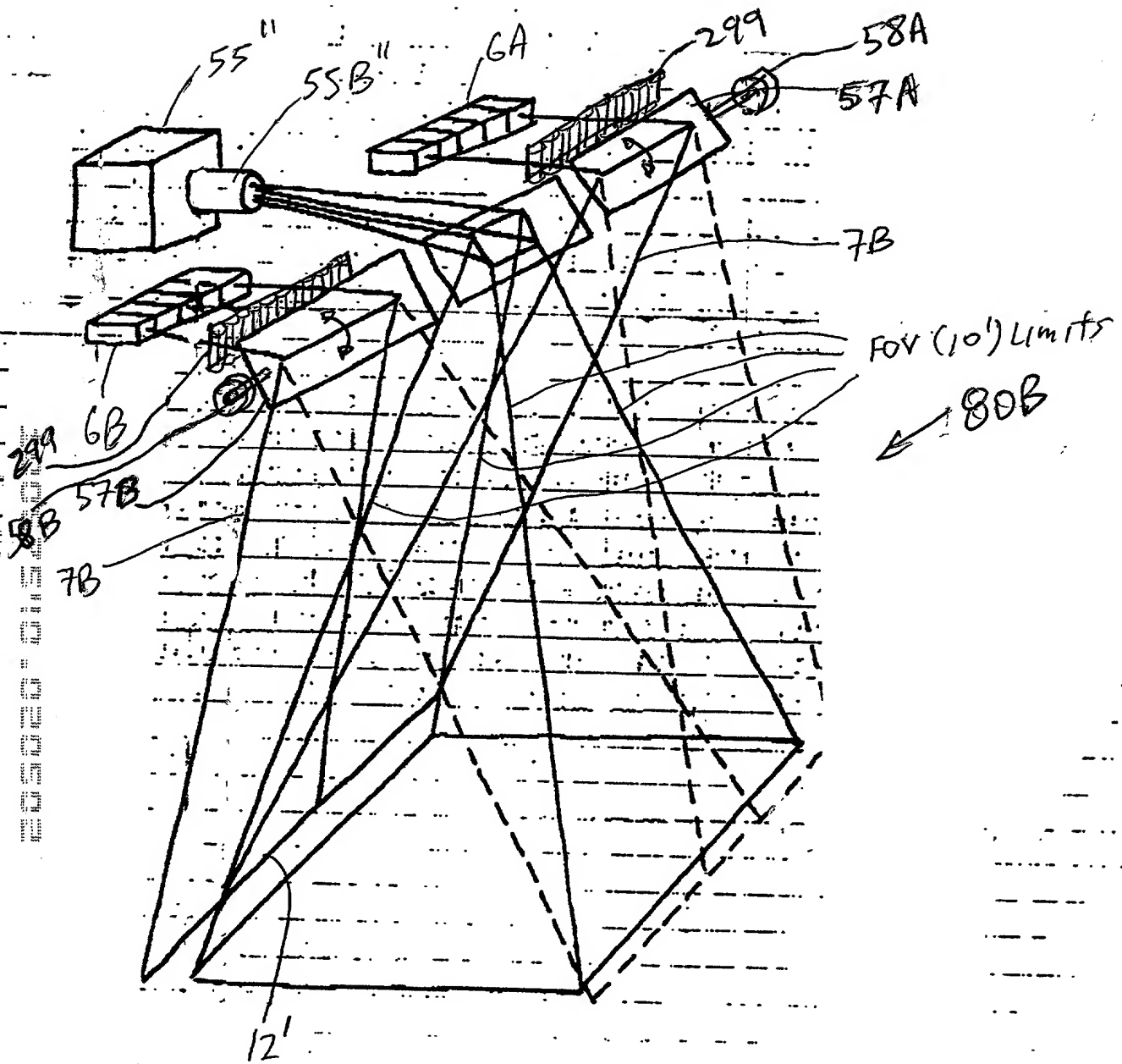
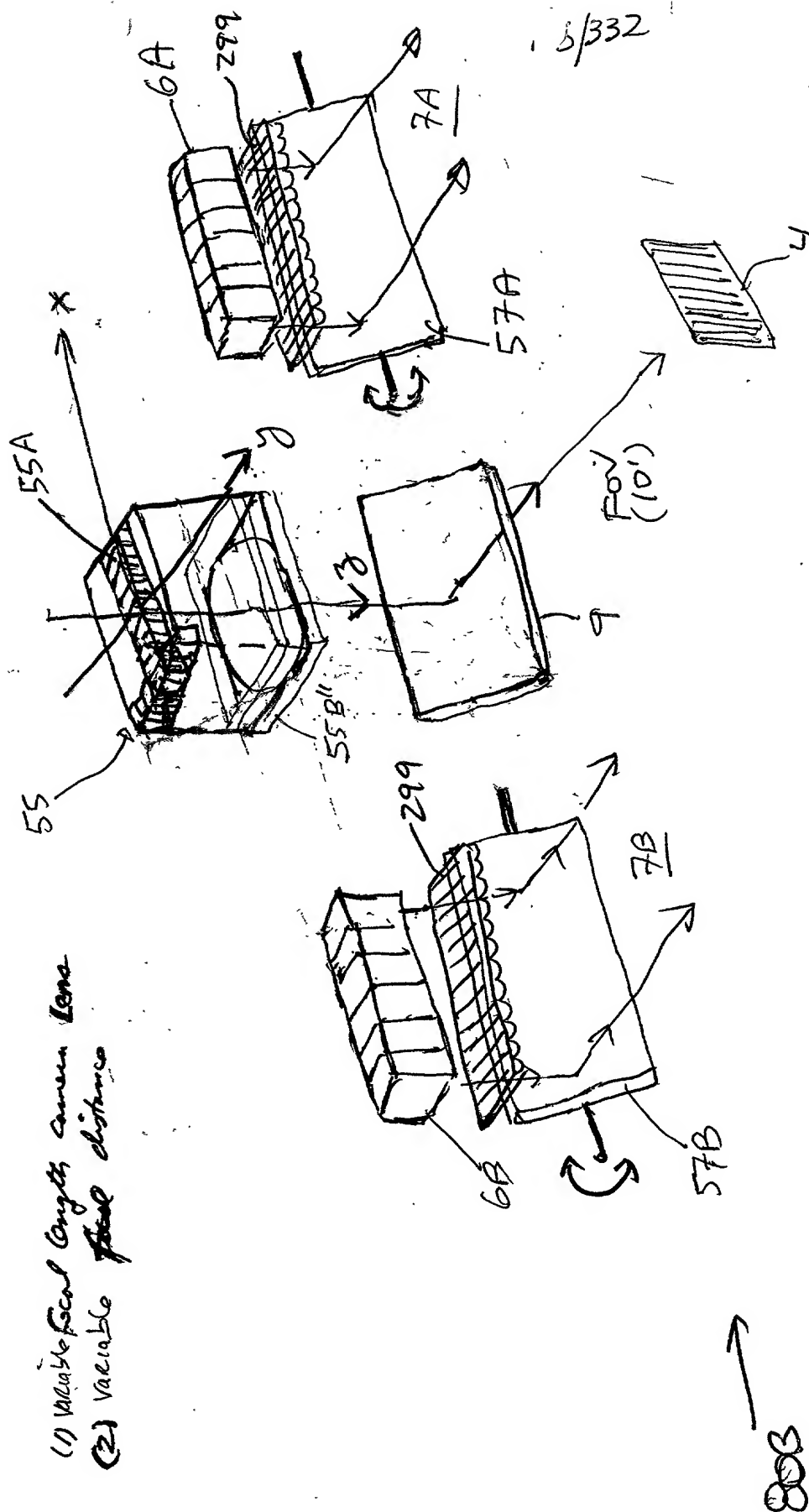
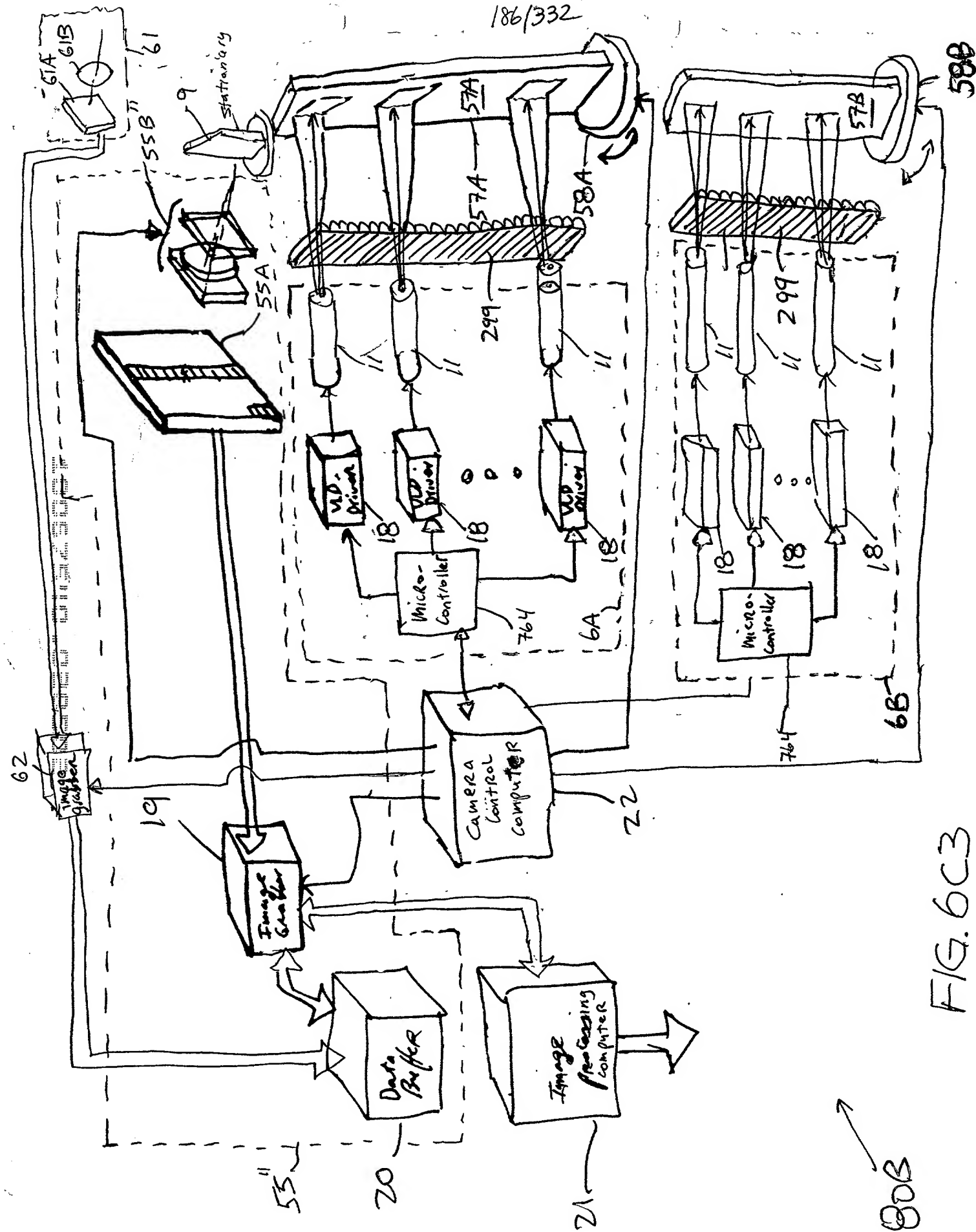


FIG. 6C1

- (1) Variable focal length camera lens
- (2) Variable focal distance





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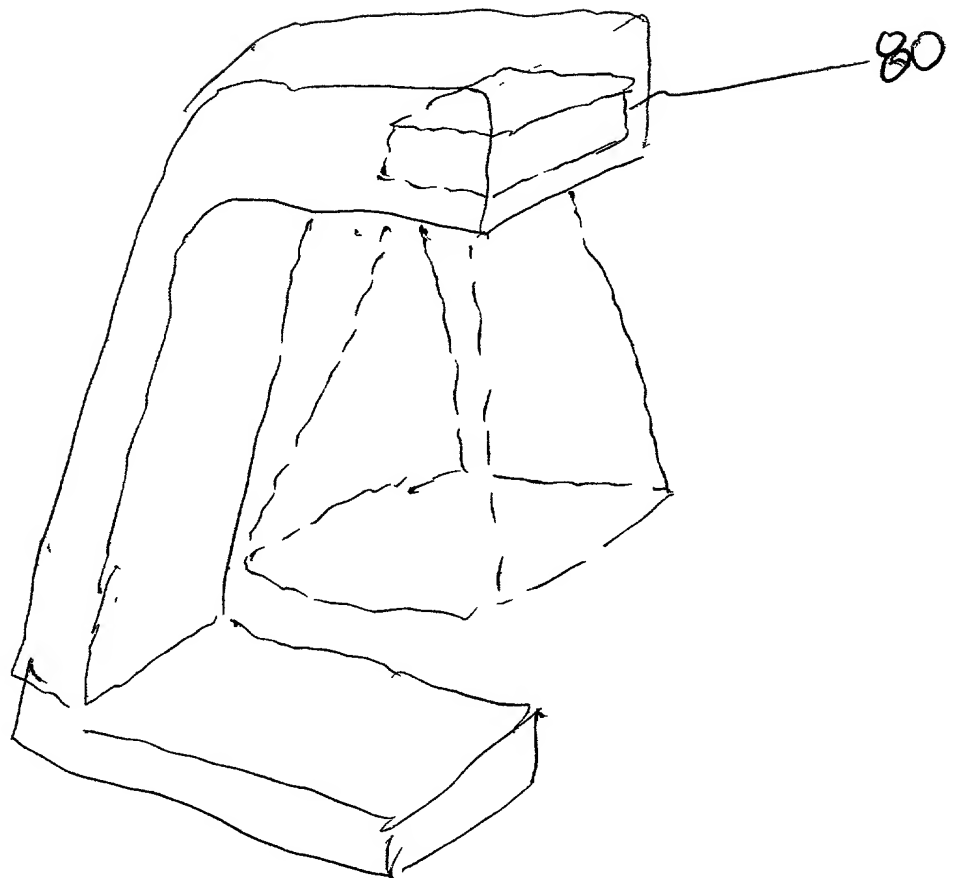


FIG. 6C5

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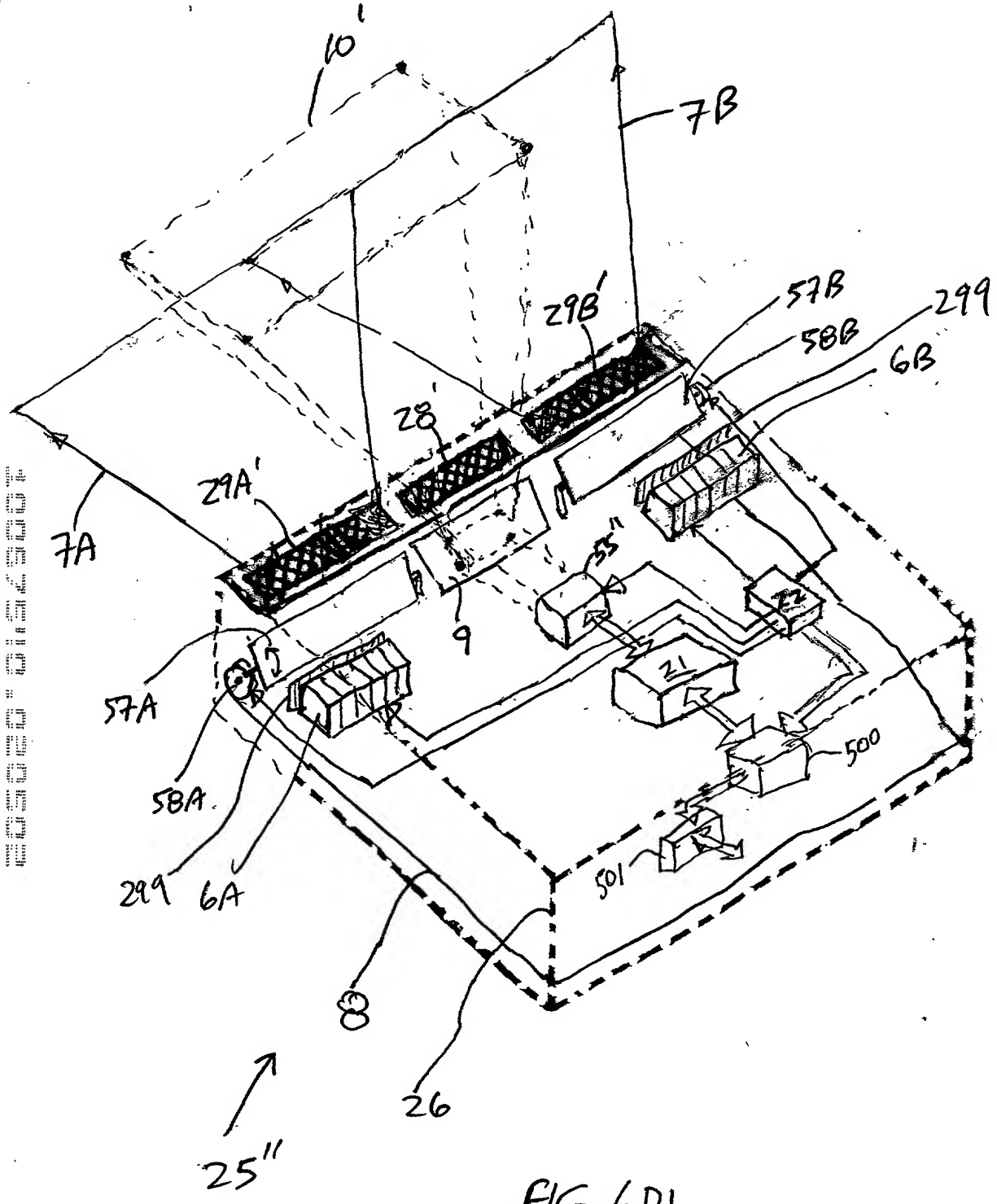


FIG. 6D1

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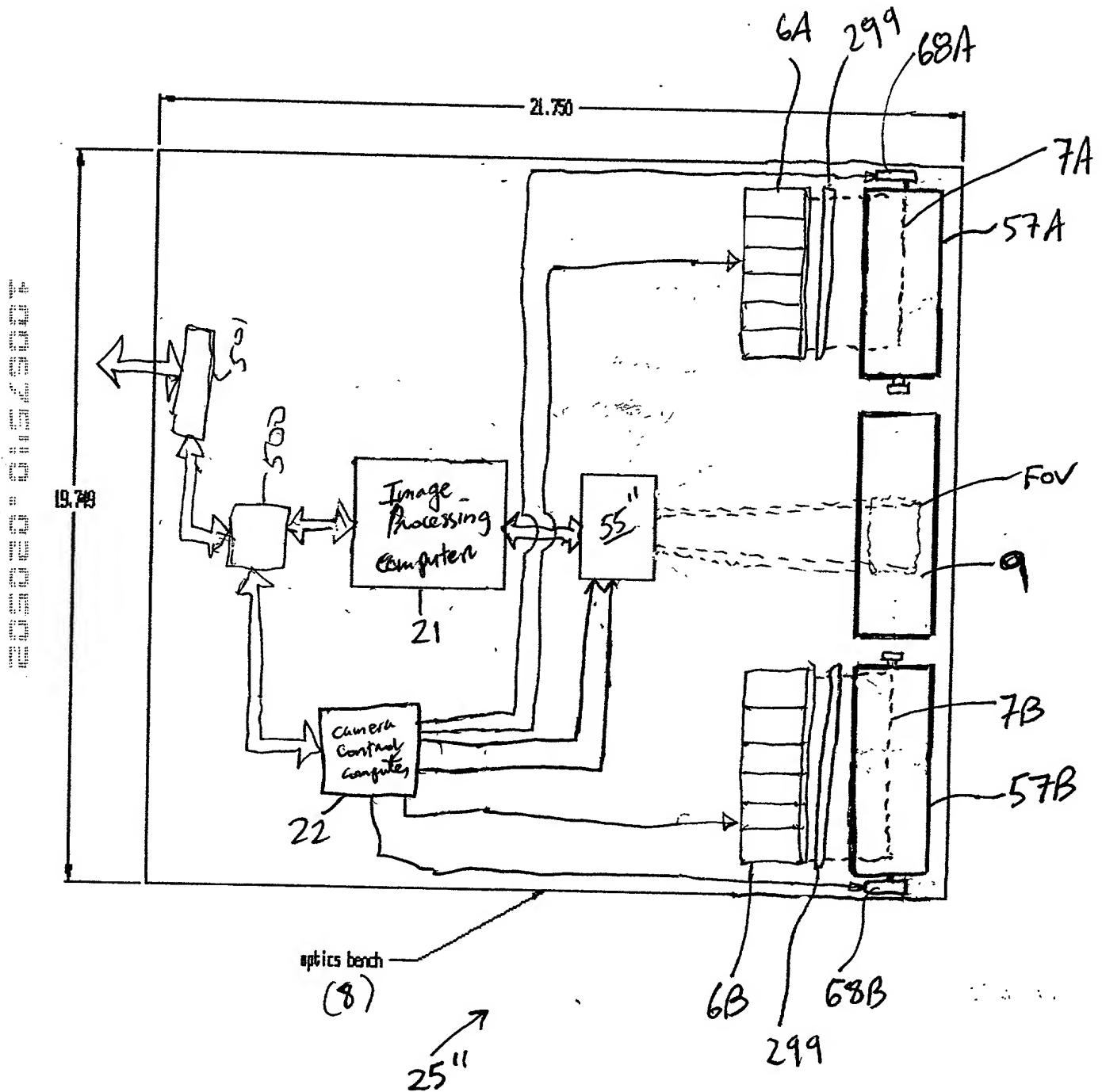
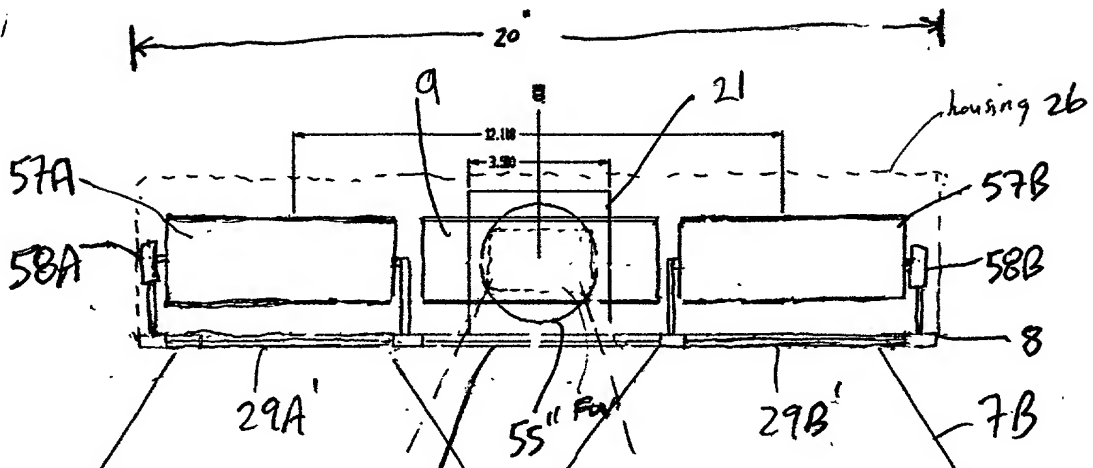


FIG. 6DZ

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Stationary
3-D
FOV

FIG. 6D3

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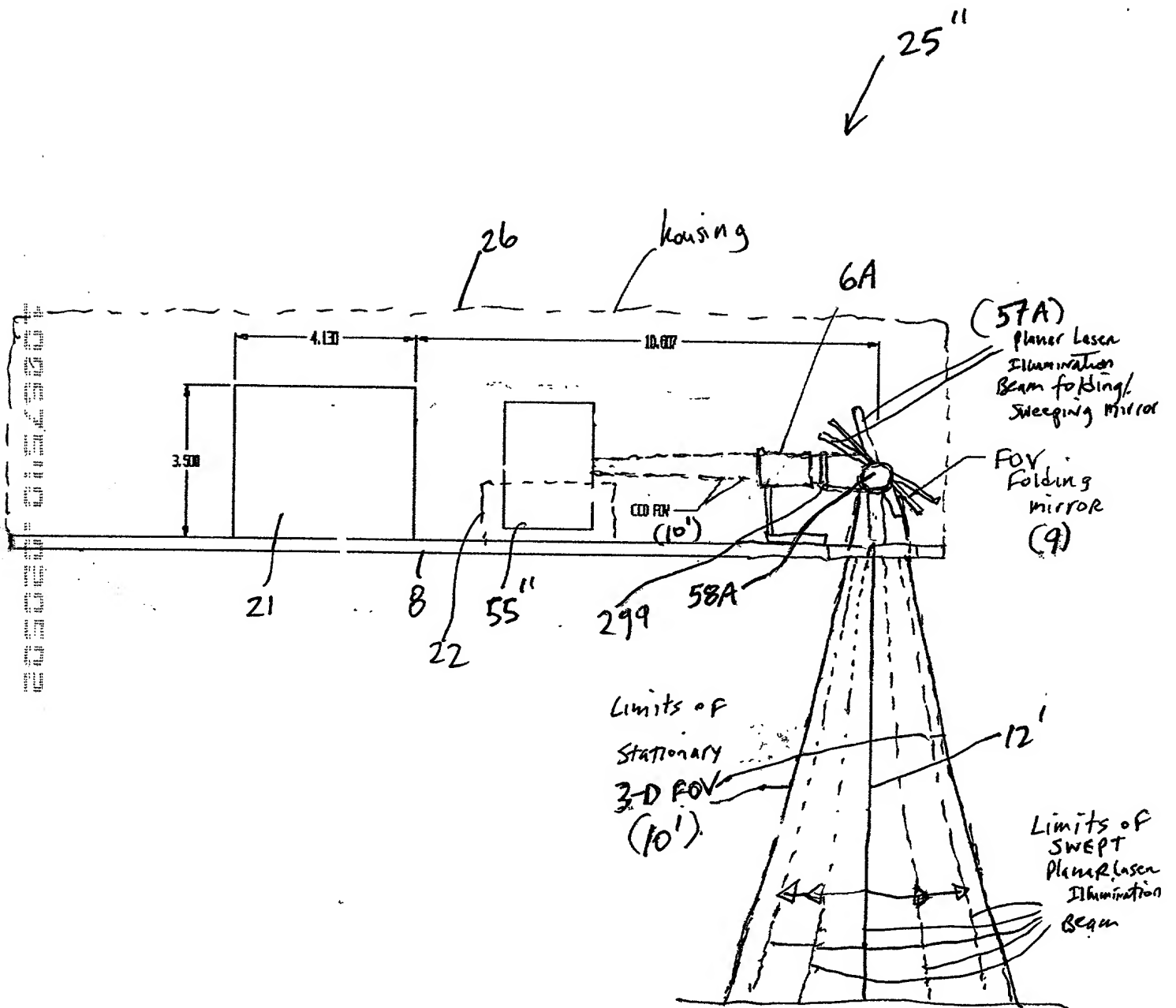


FIG. 6D4

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variable FOV

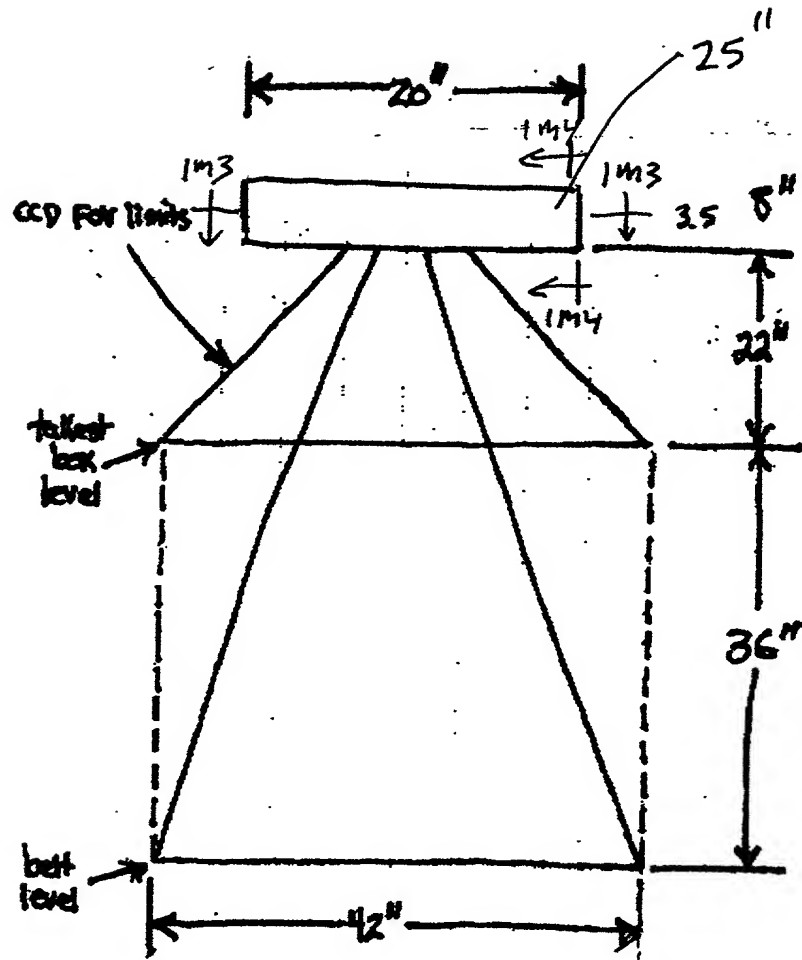


FIG. 6D5

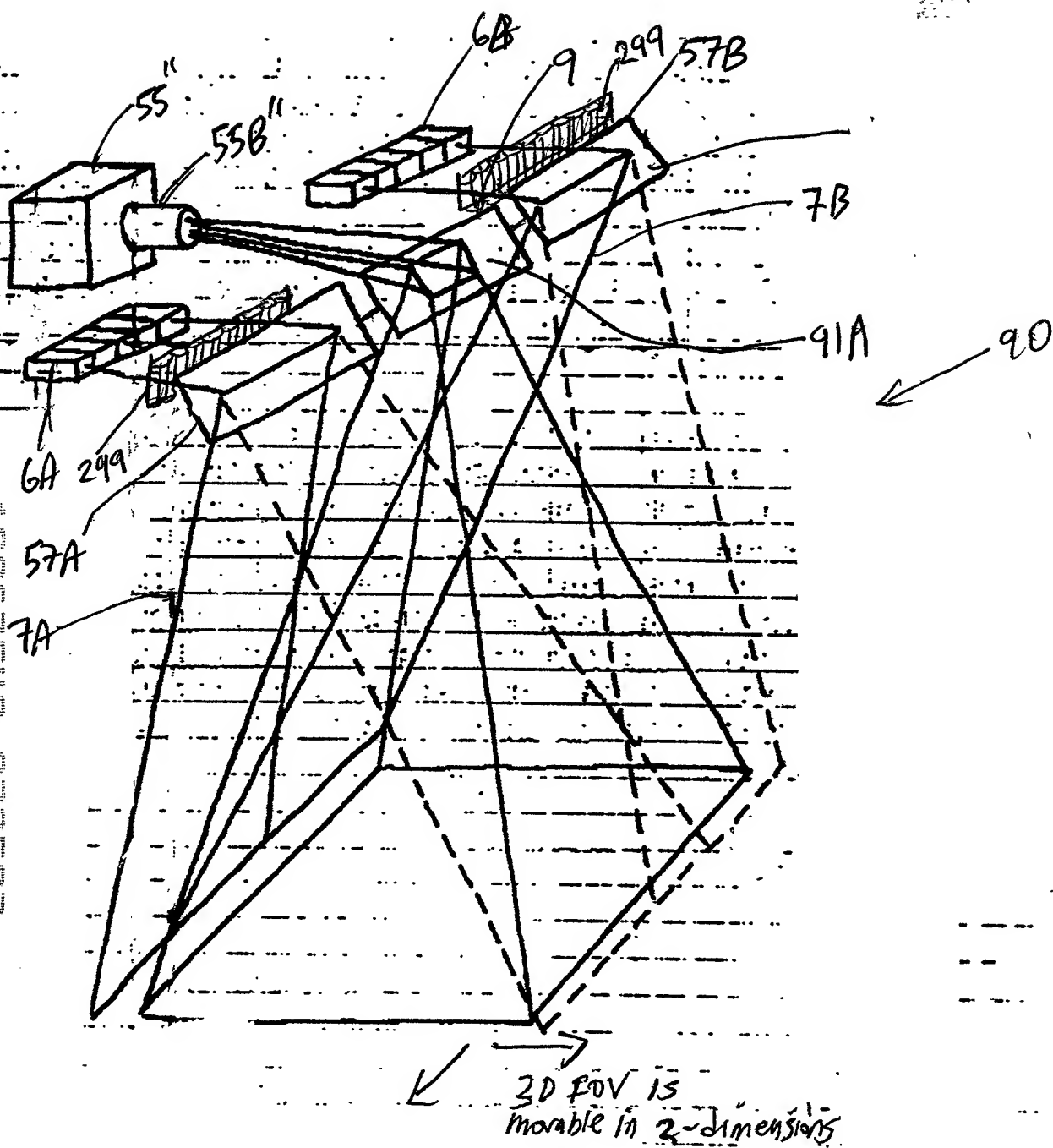


FIG 6E1

1951332

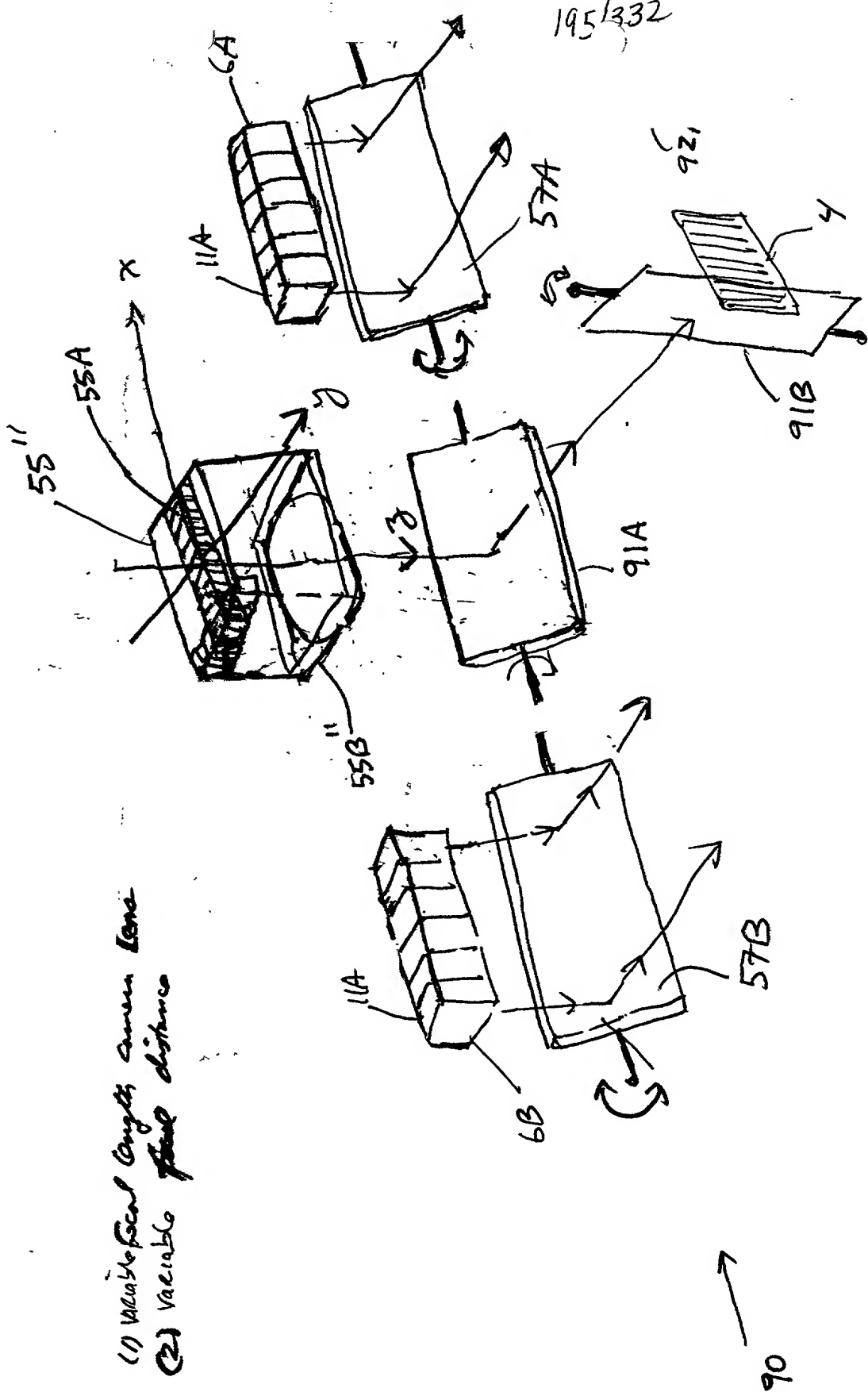


FIG. 6E2

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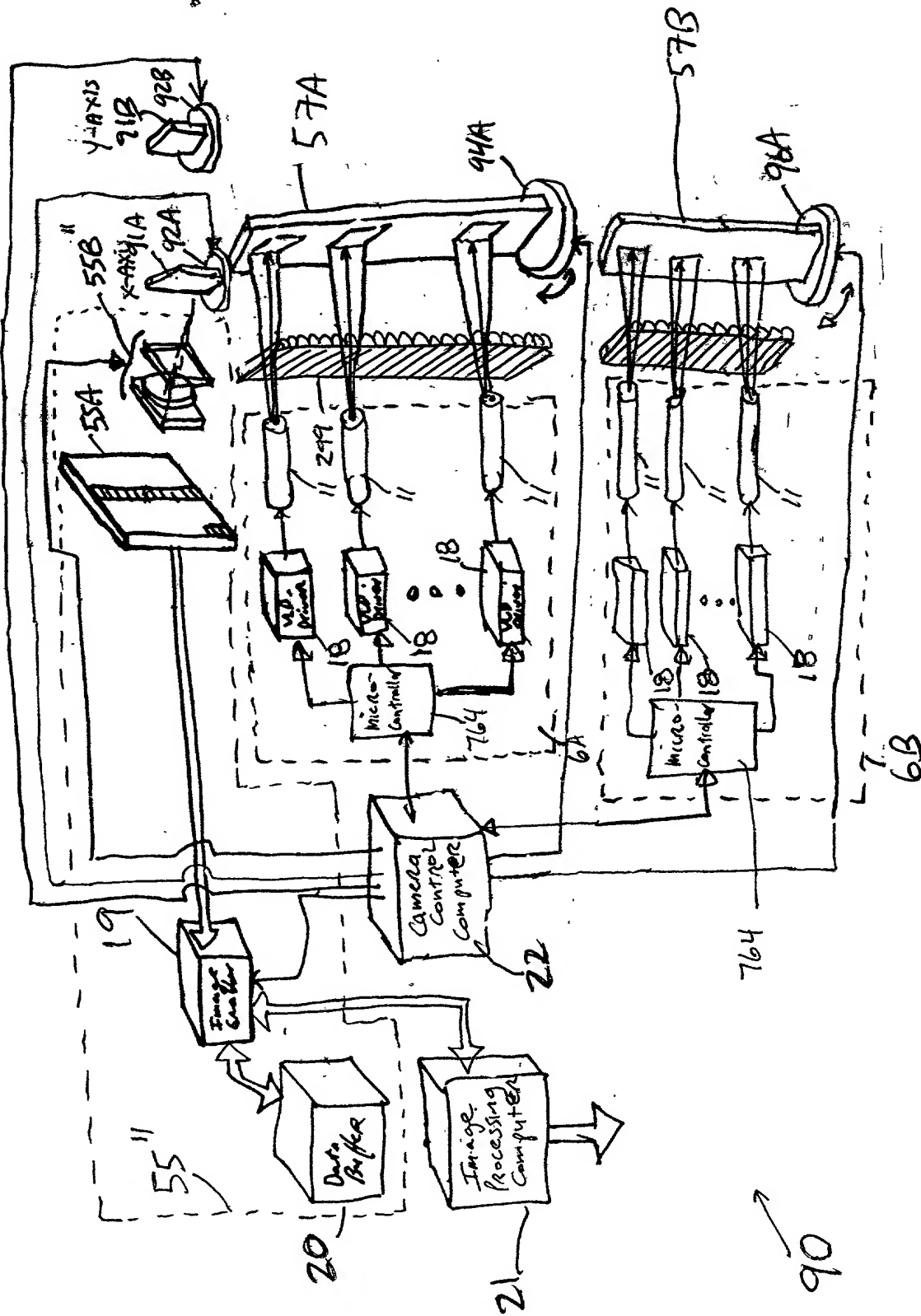


FIG. 6E3

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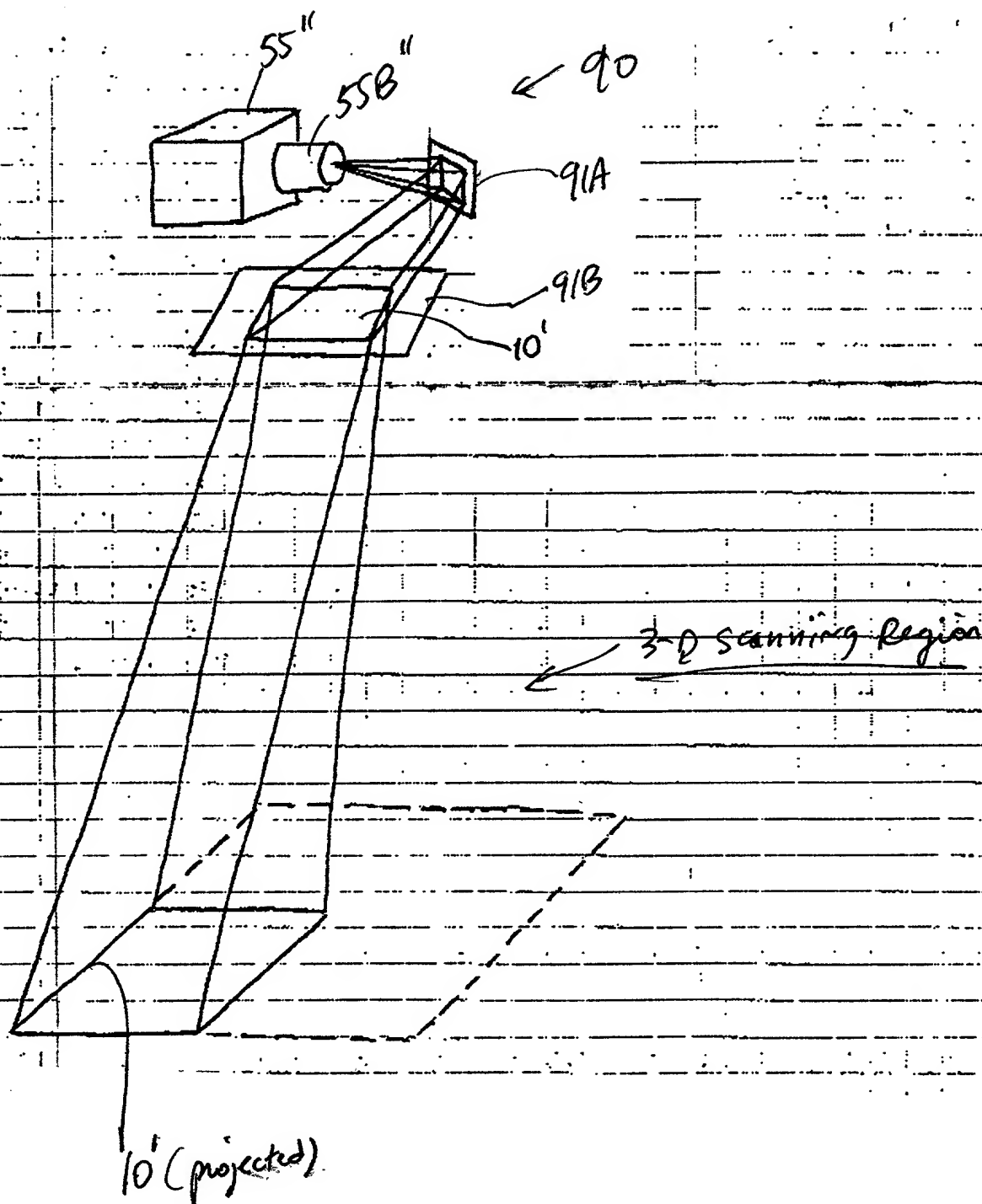


FIG. 6E4

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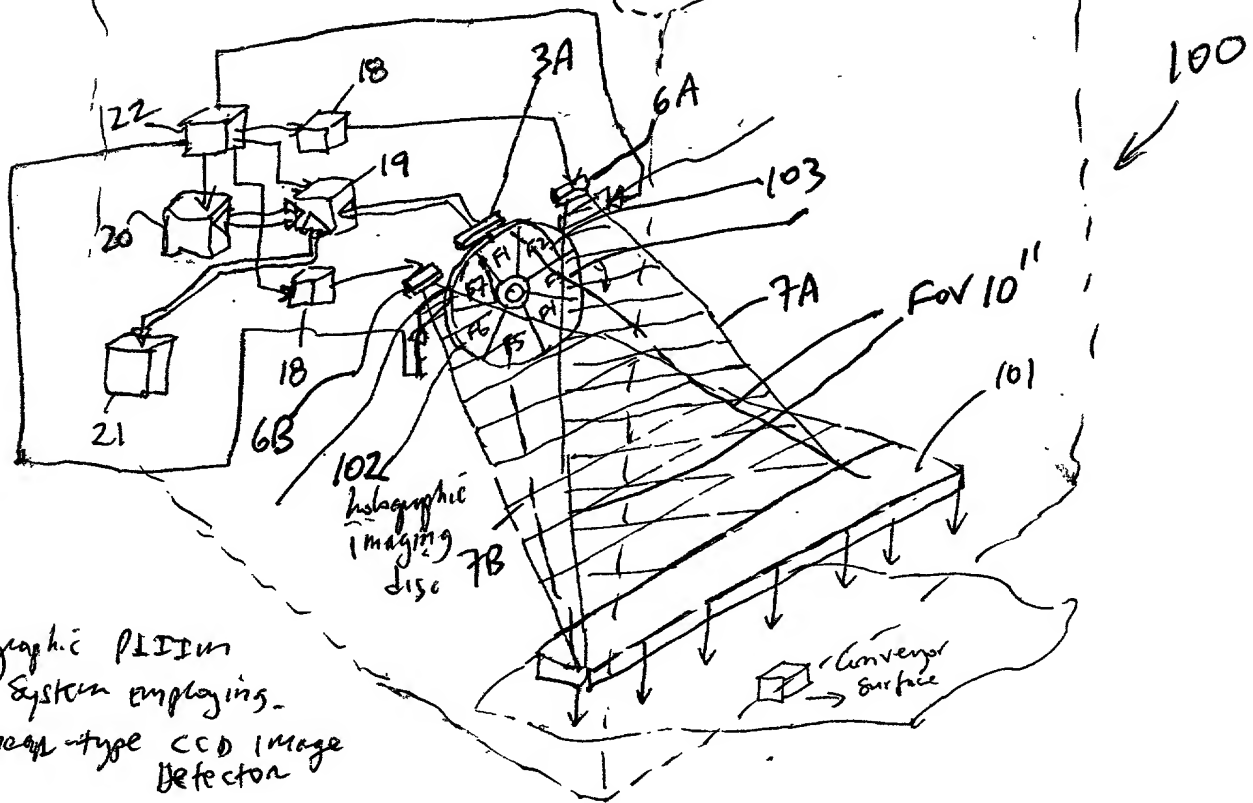


FIG. 7A

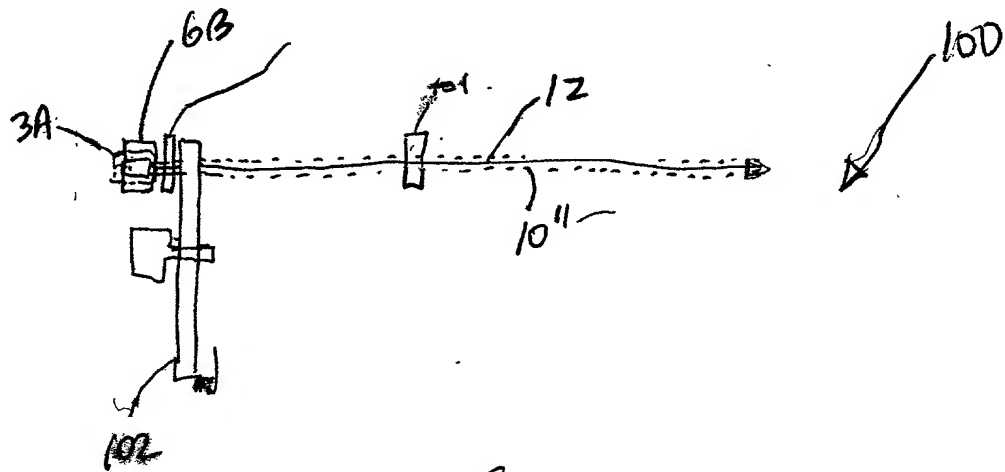
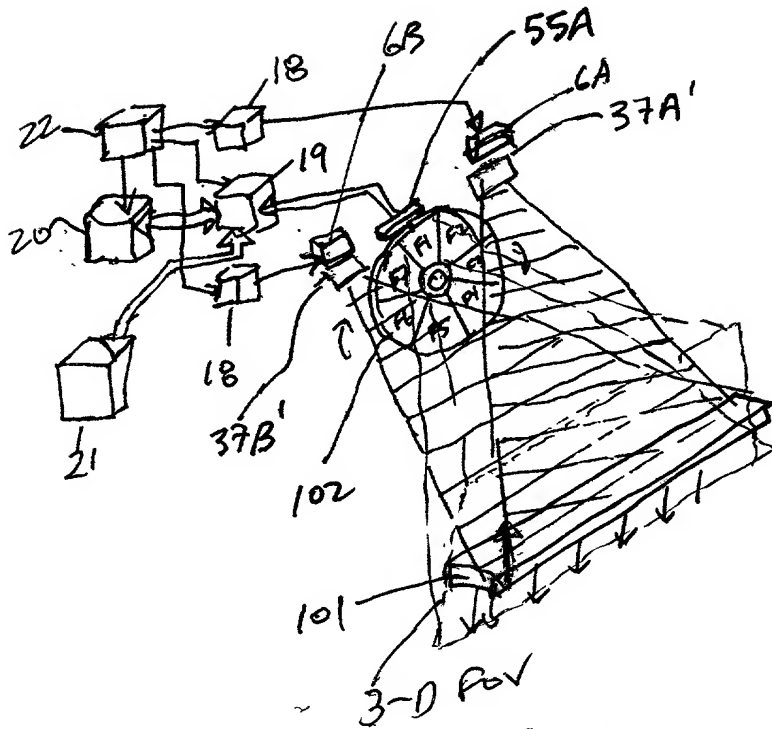


FIG. 7B

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Holographic PLIEM
System employing
Area-Type
CCD Image
Detector
100

FIG. 8A

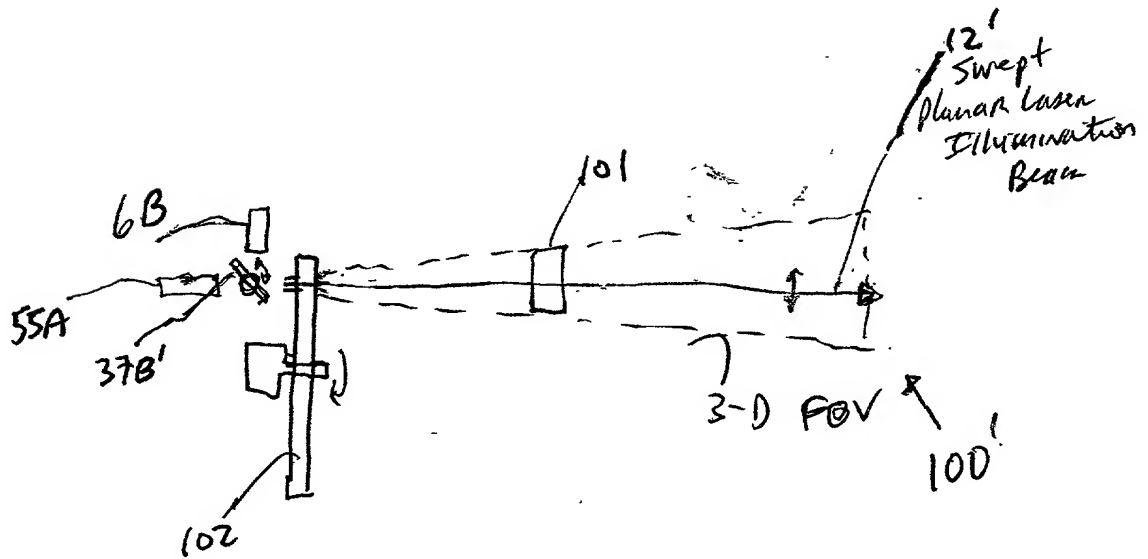


FIG. 8B

1-D CCD SCANNER EMBODIMENT

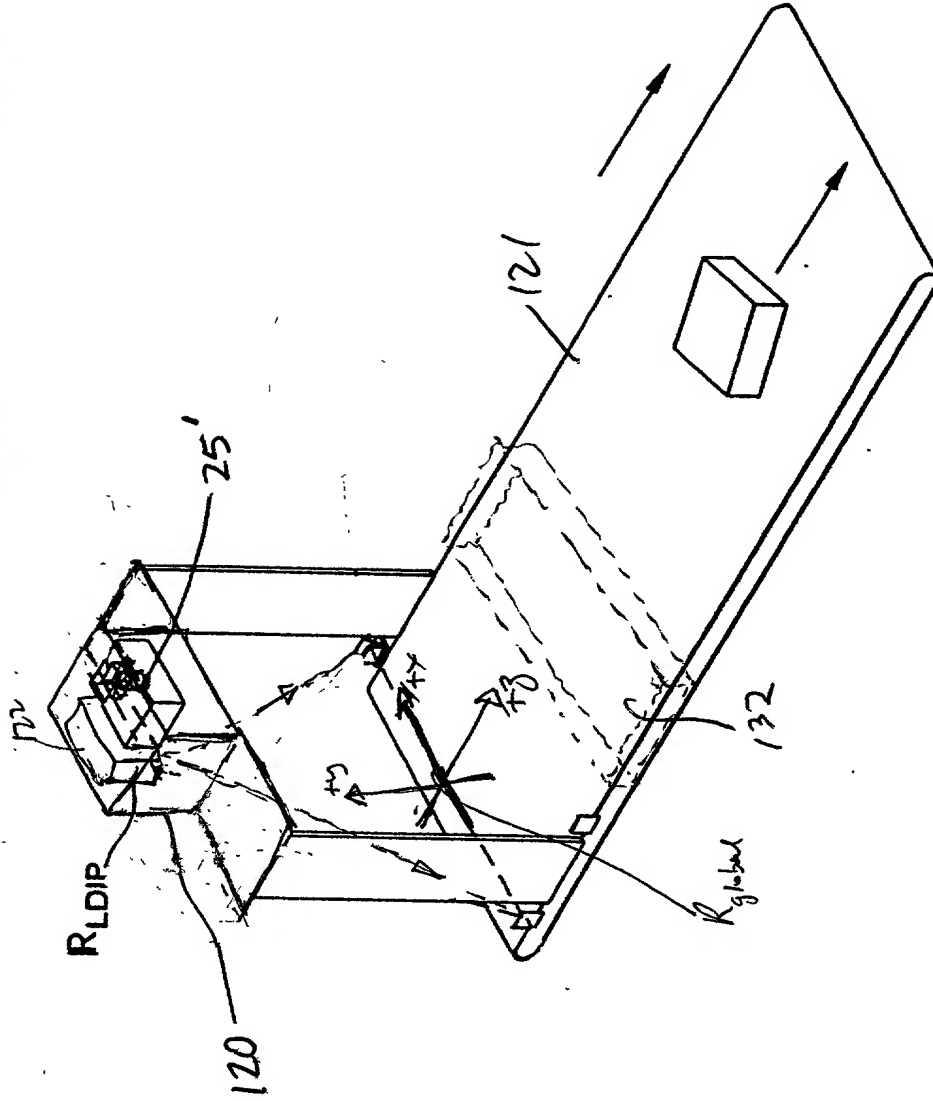


FIG. 9

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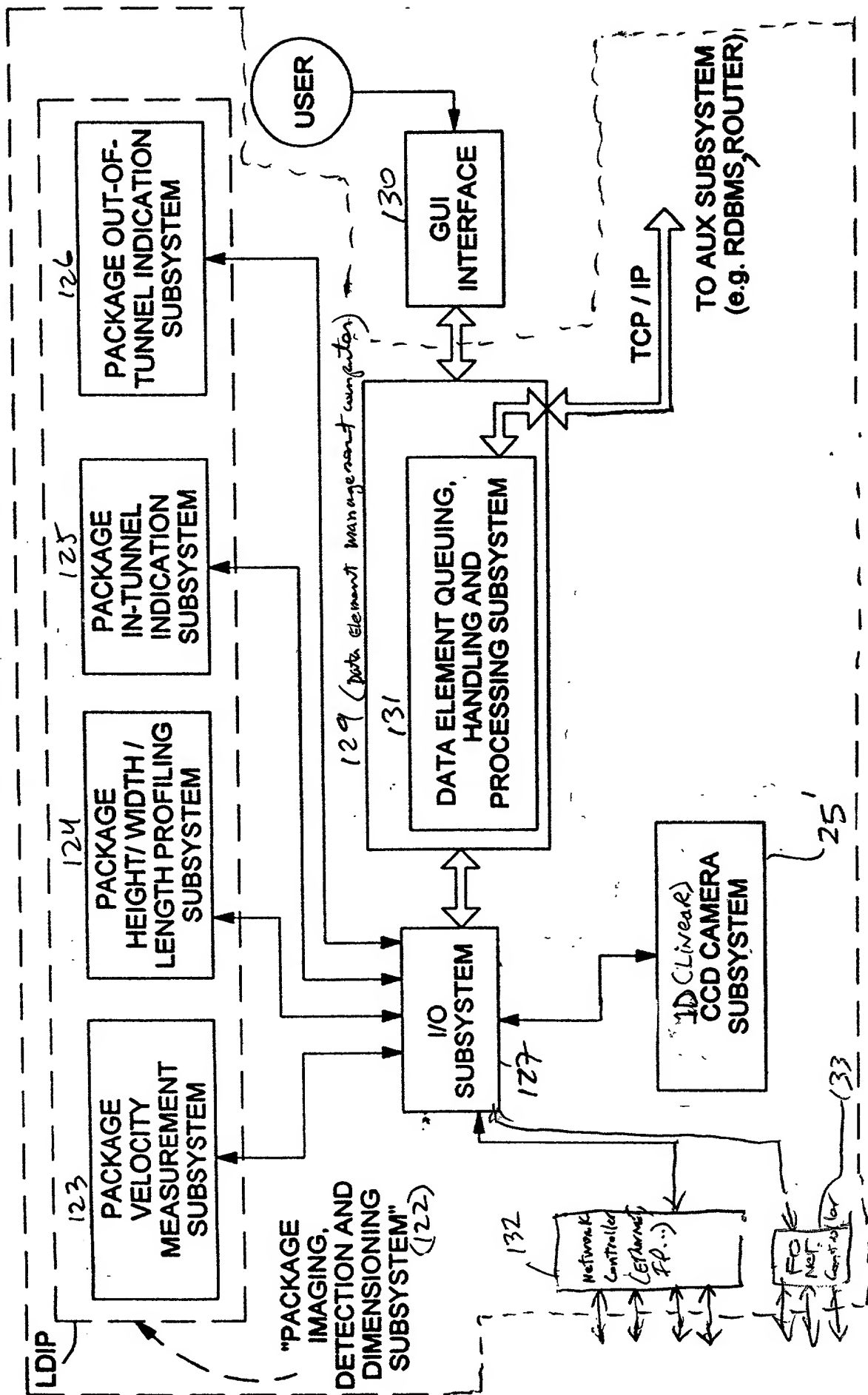


FIG. 10

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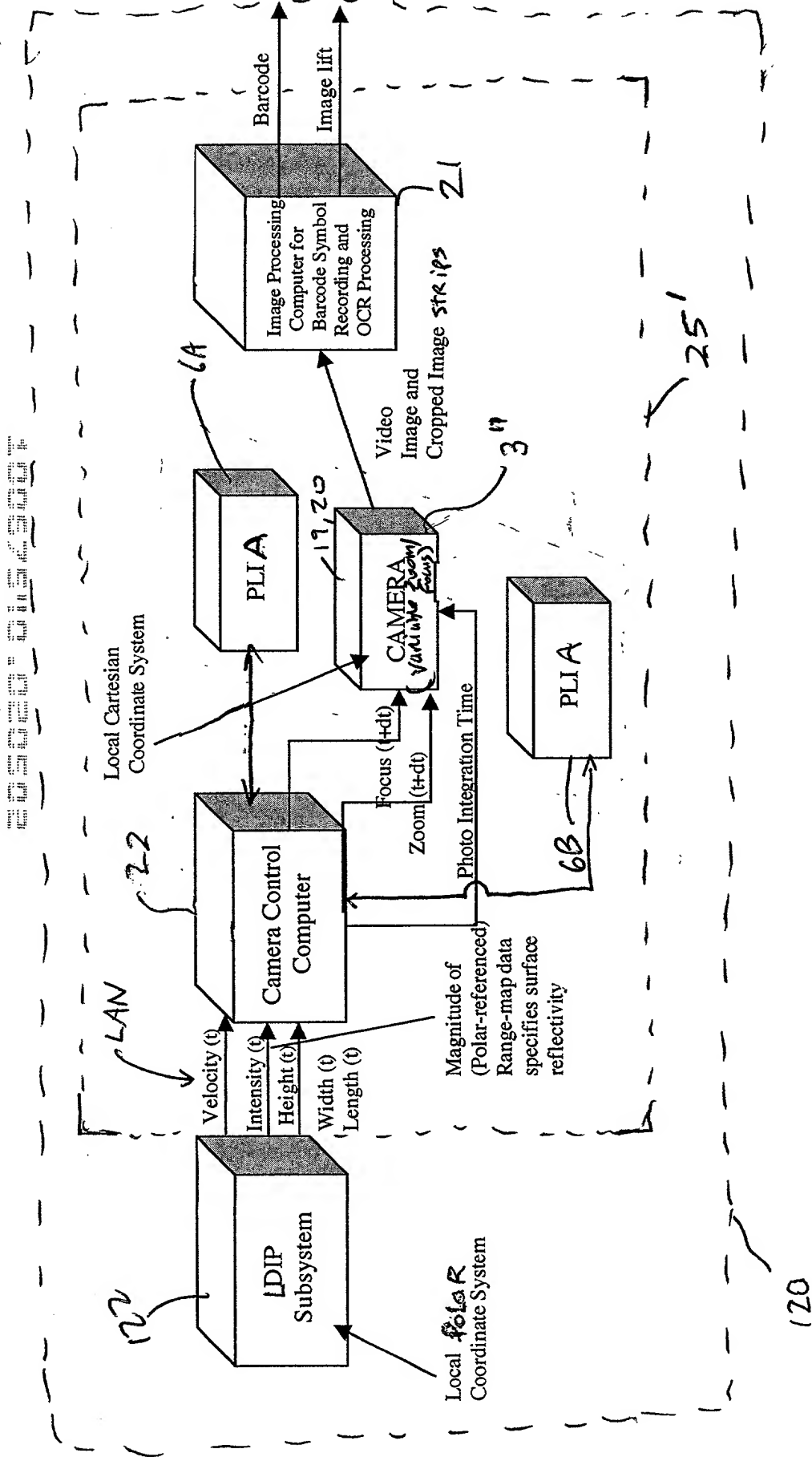


FIG. 11

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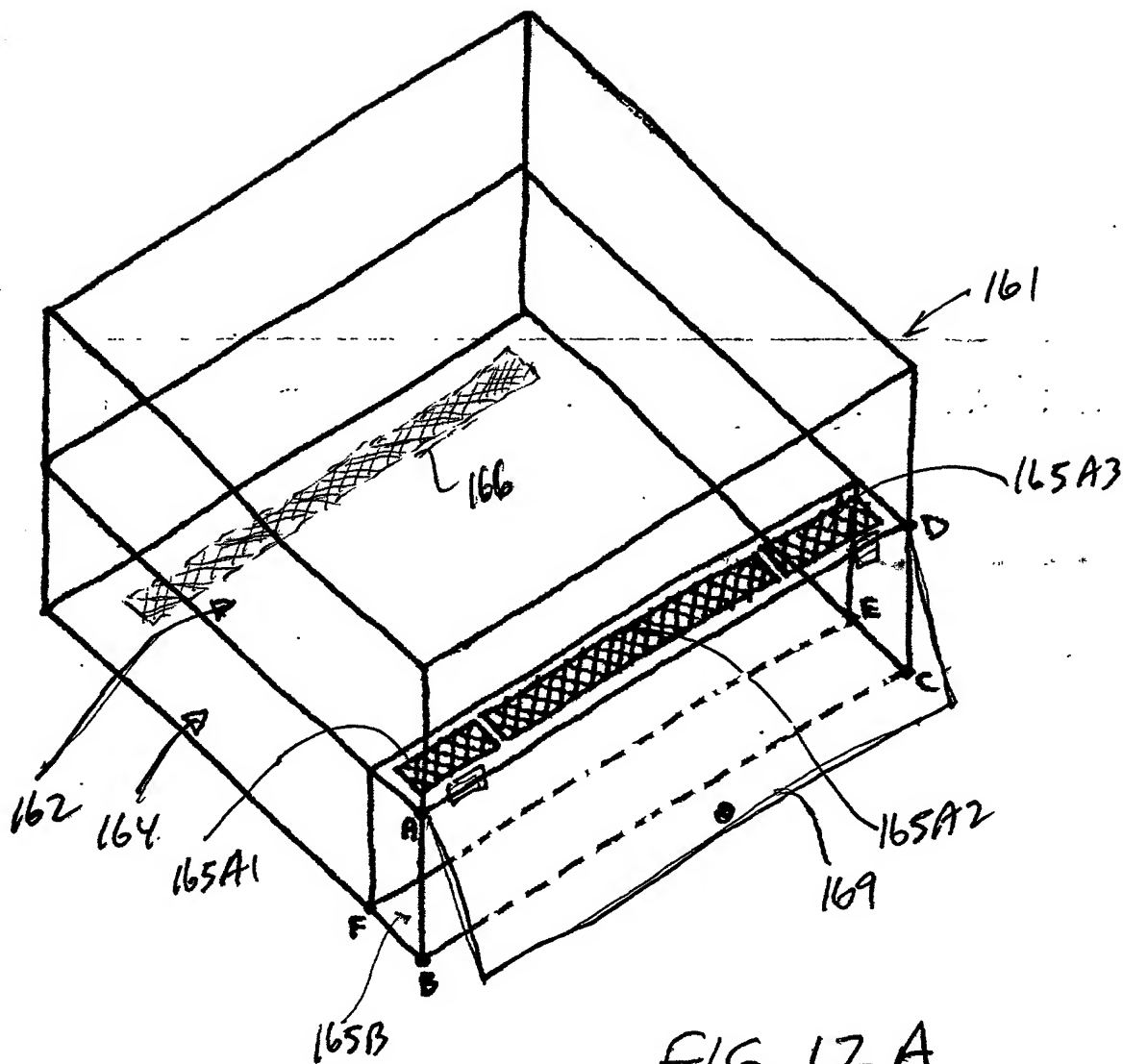


FIG. 12A

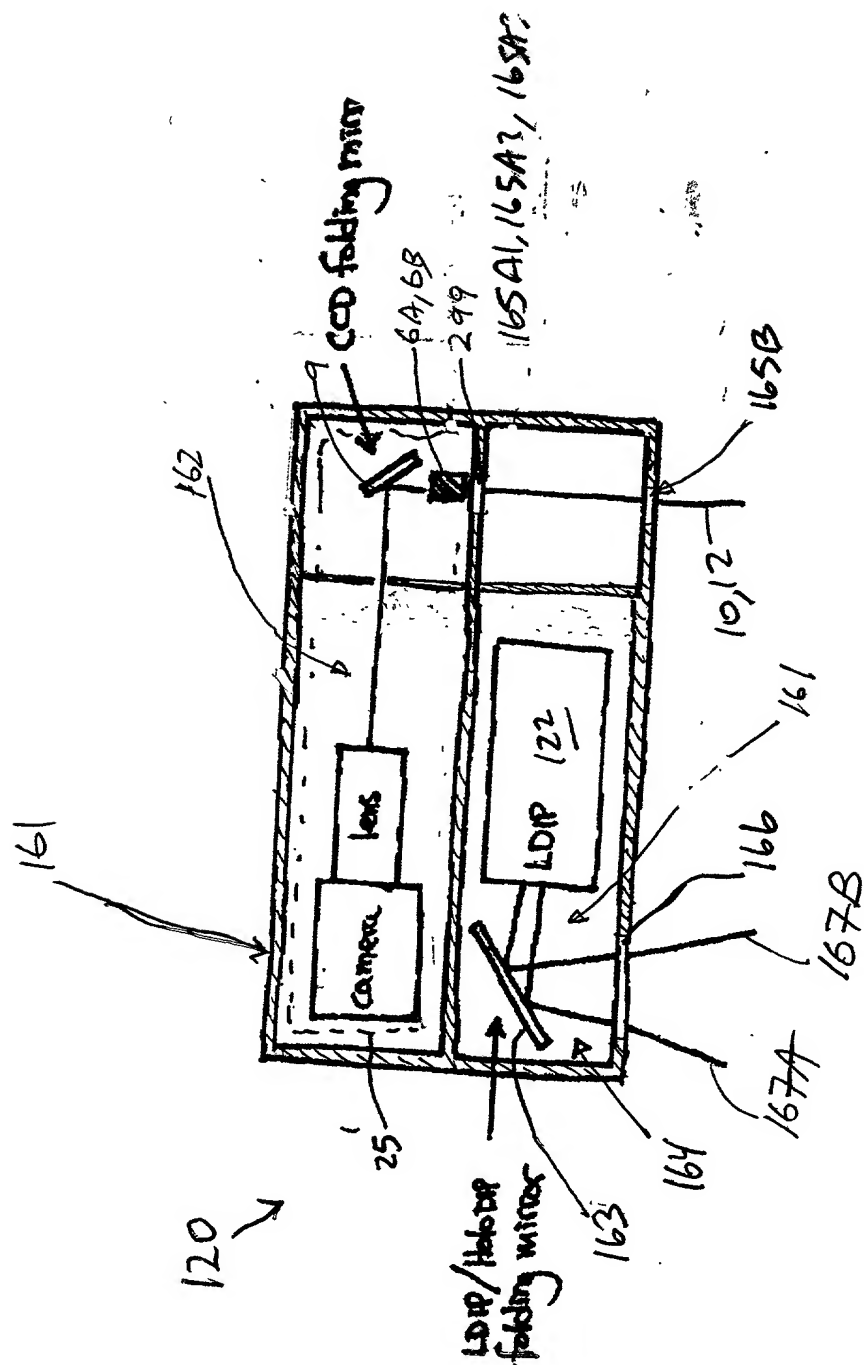


FIG. 12B

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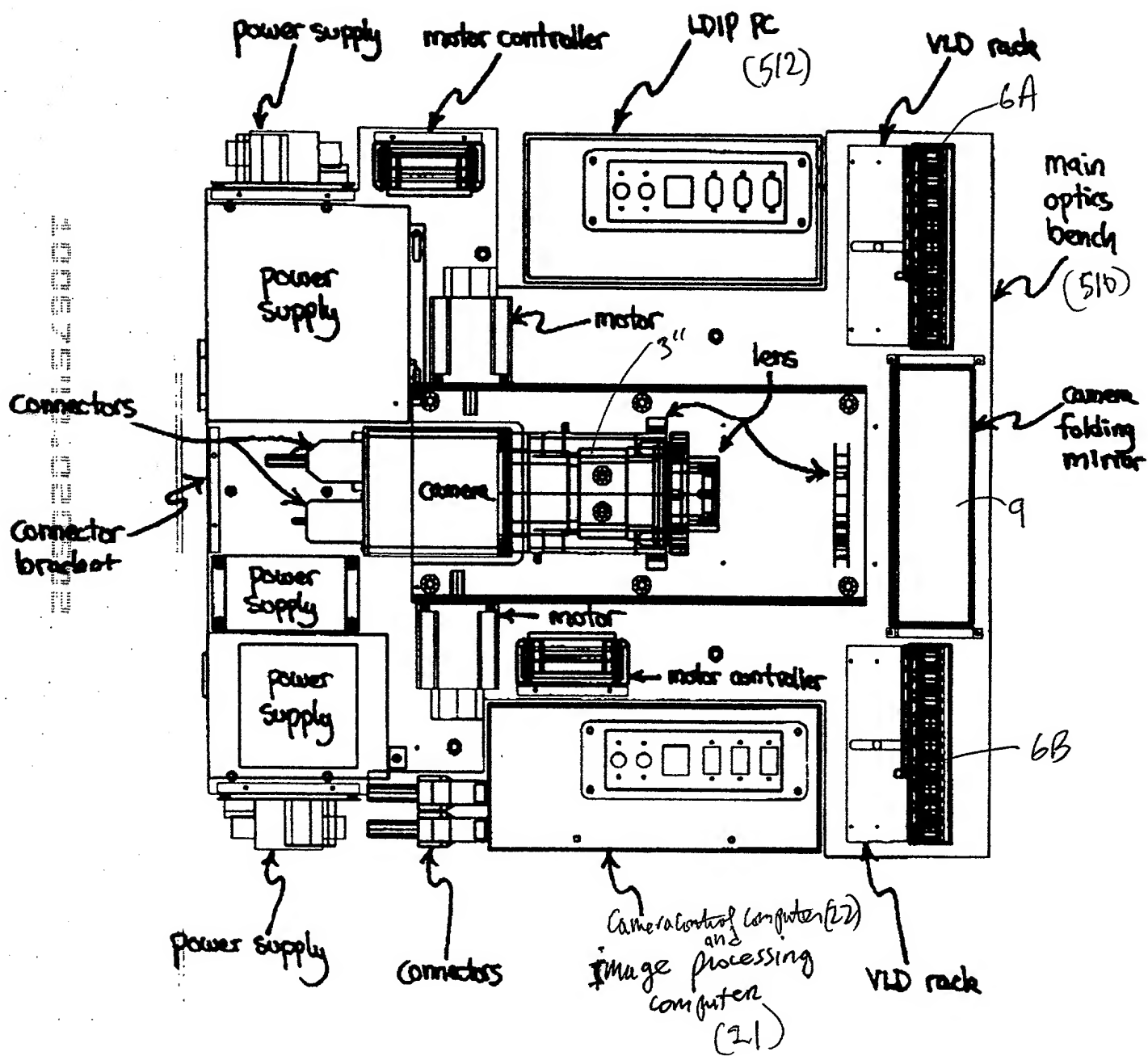


FIG. 12C

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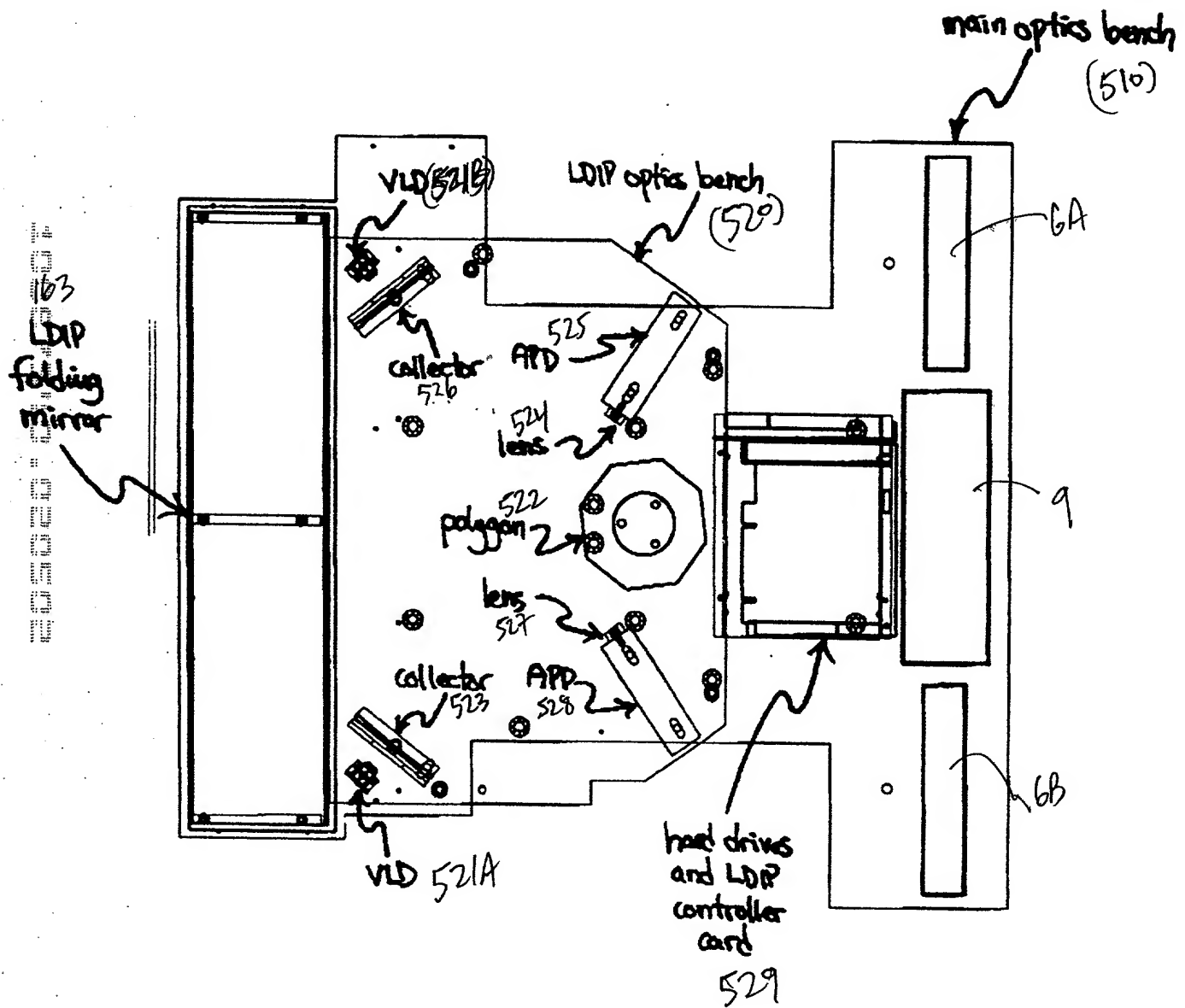
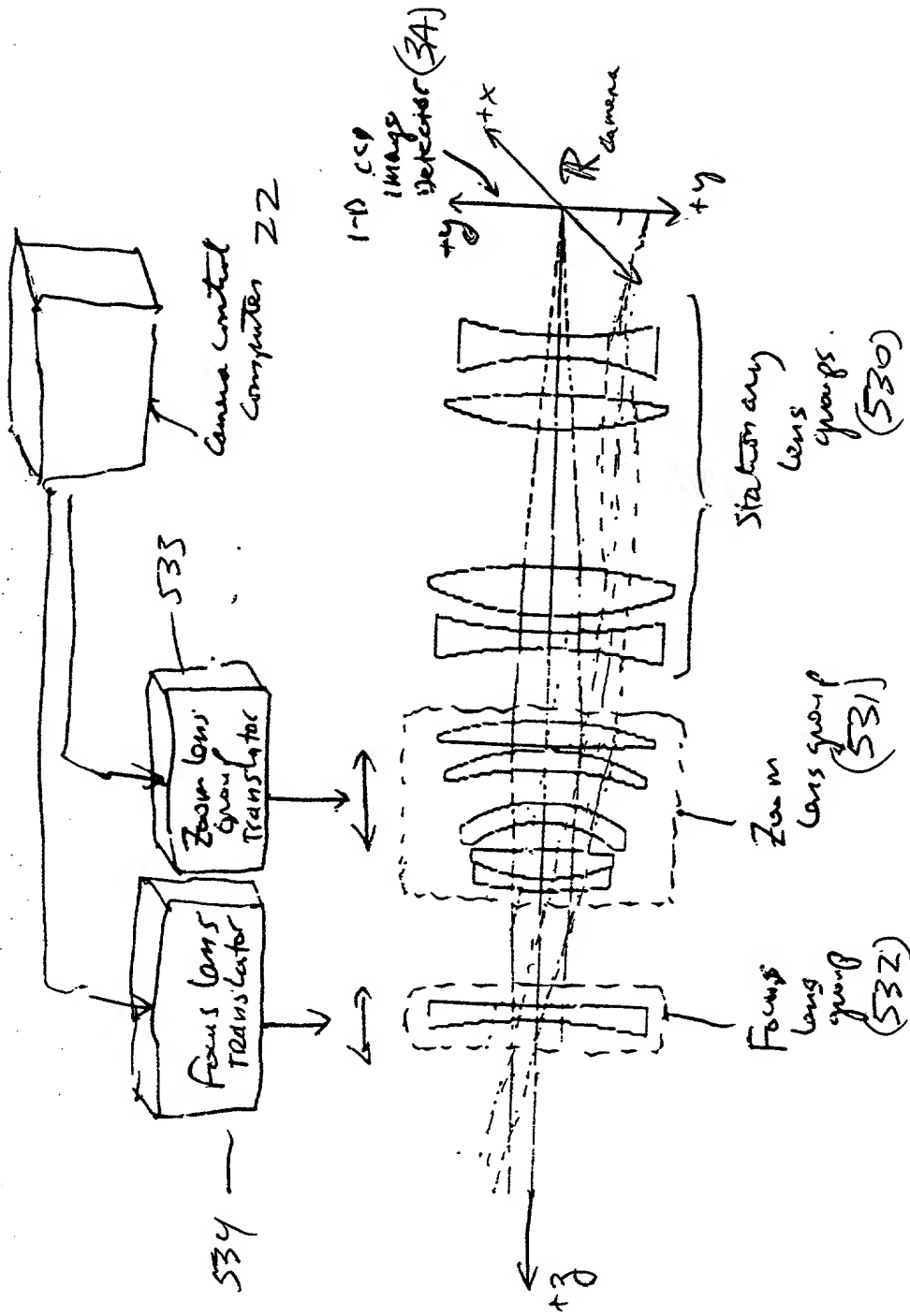


FIG 12D

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(main optics)
(lens groups)

FIG. 12E

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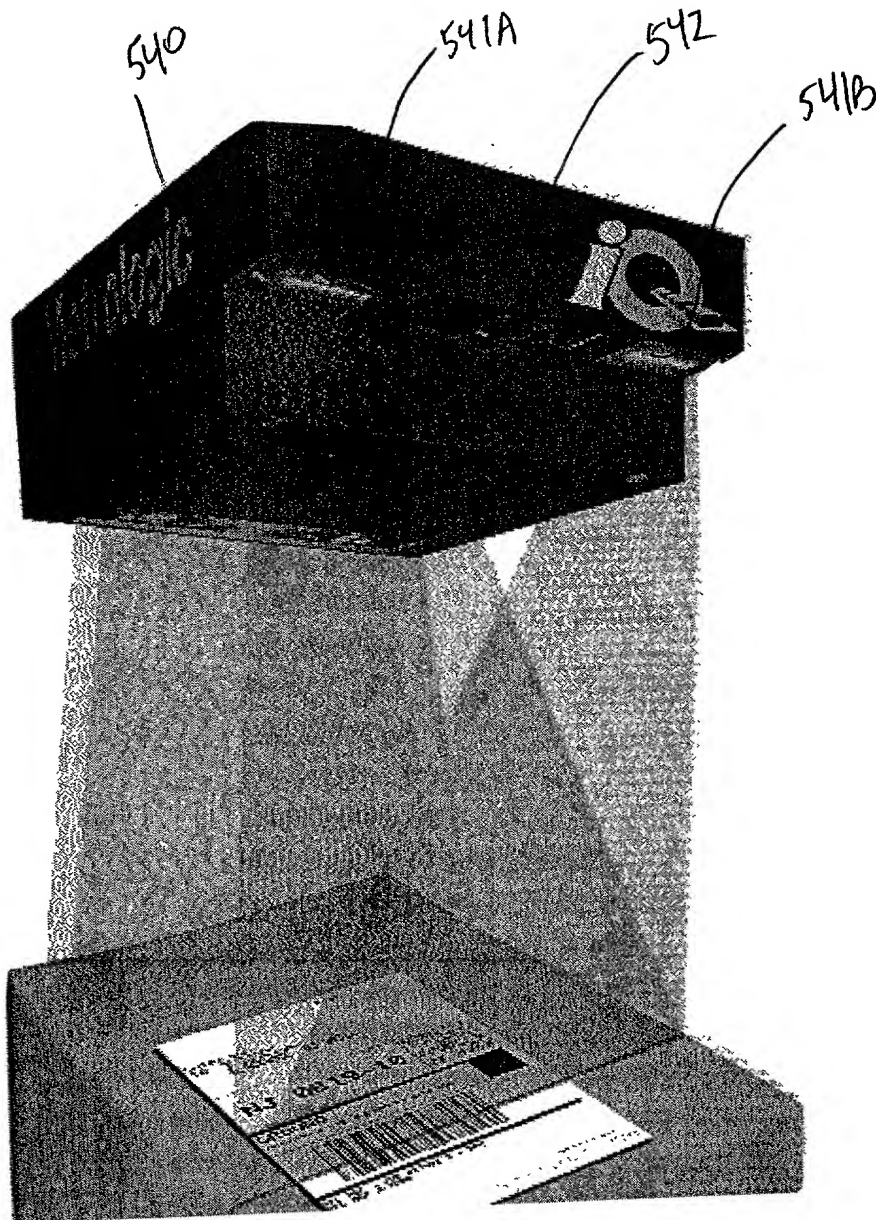


FIG. 13A

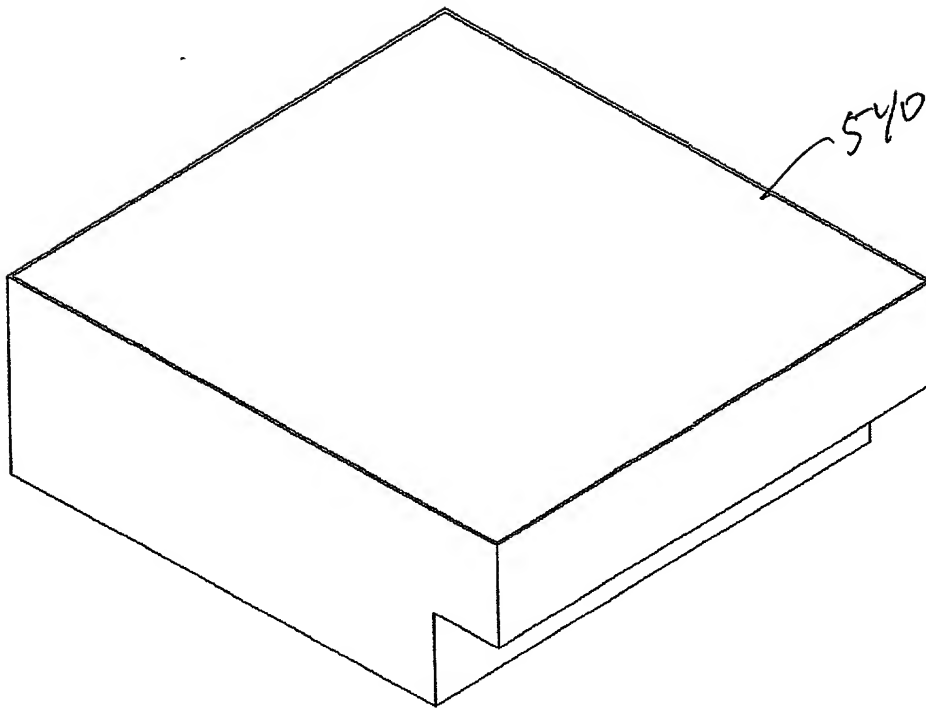


FIG. 13B

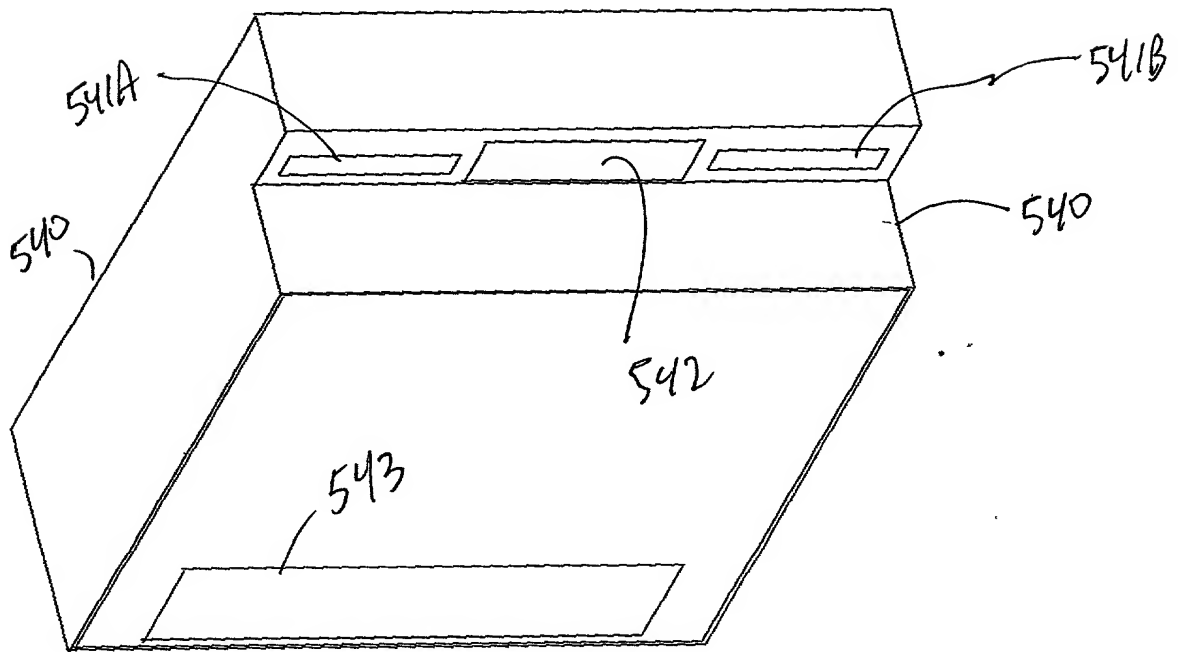


FIG. 13C

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PLLIM-BASED PACKAGE IDENTIFICATION AND DIMENSIONING (PID) SYSTEM

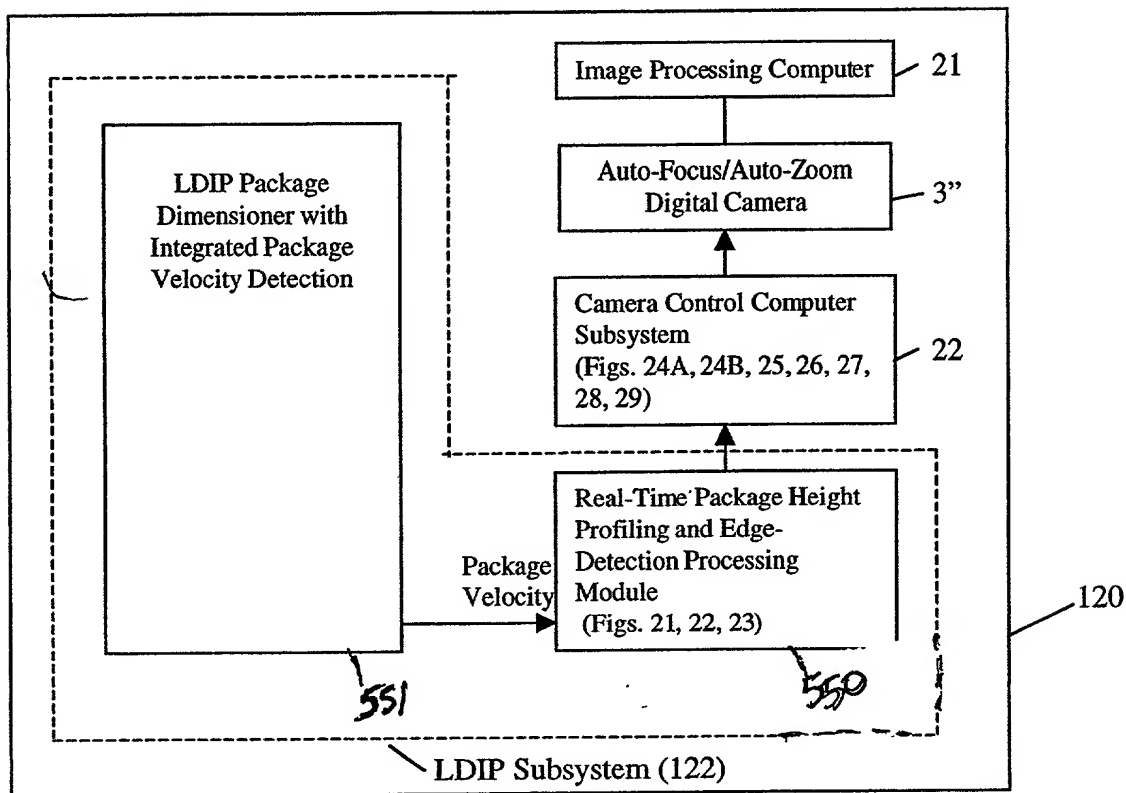


FIG. 14

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LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

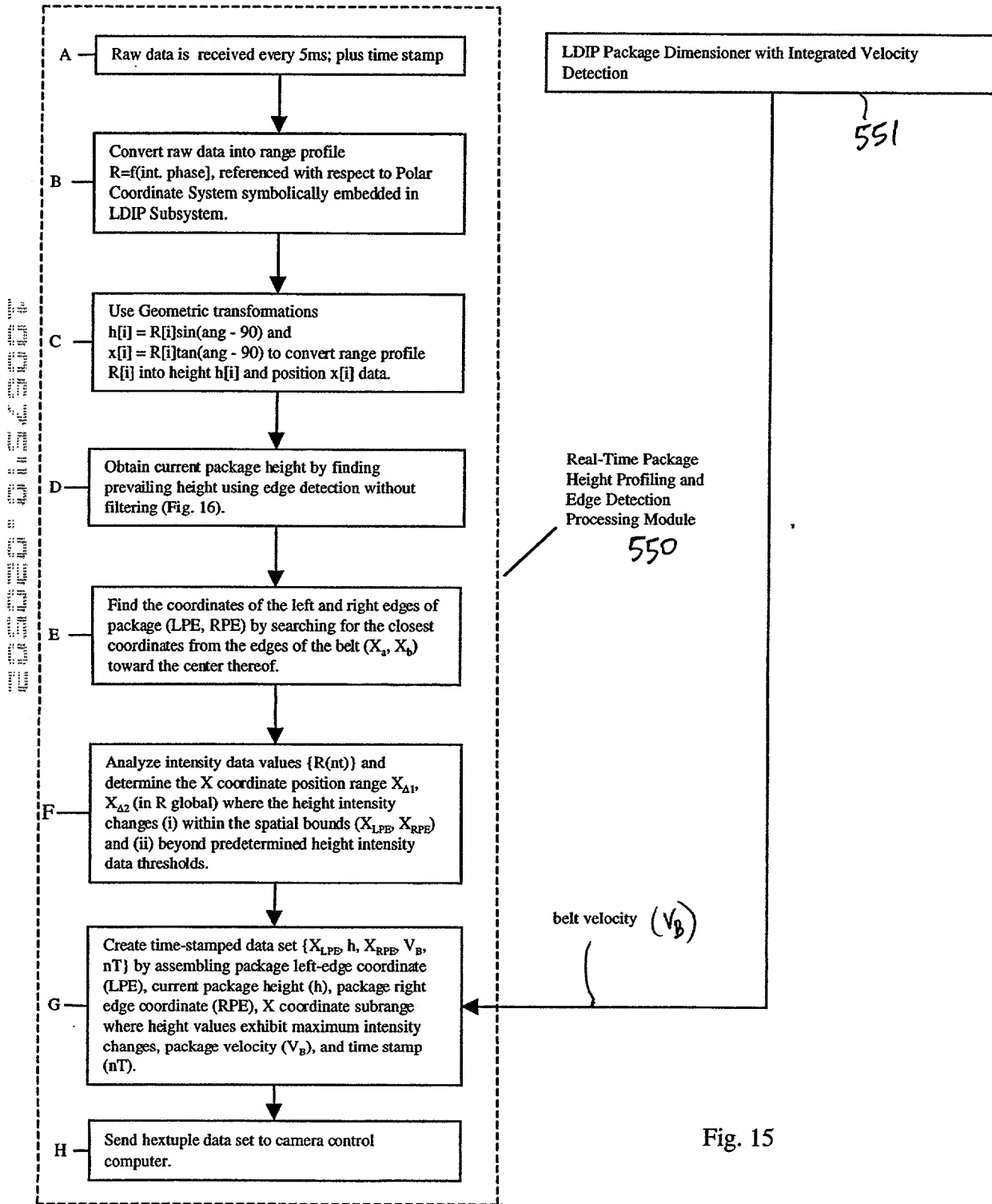
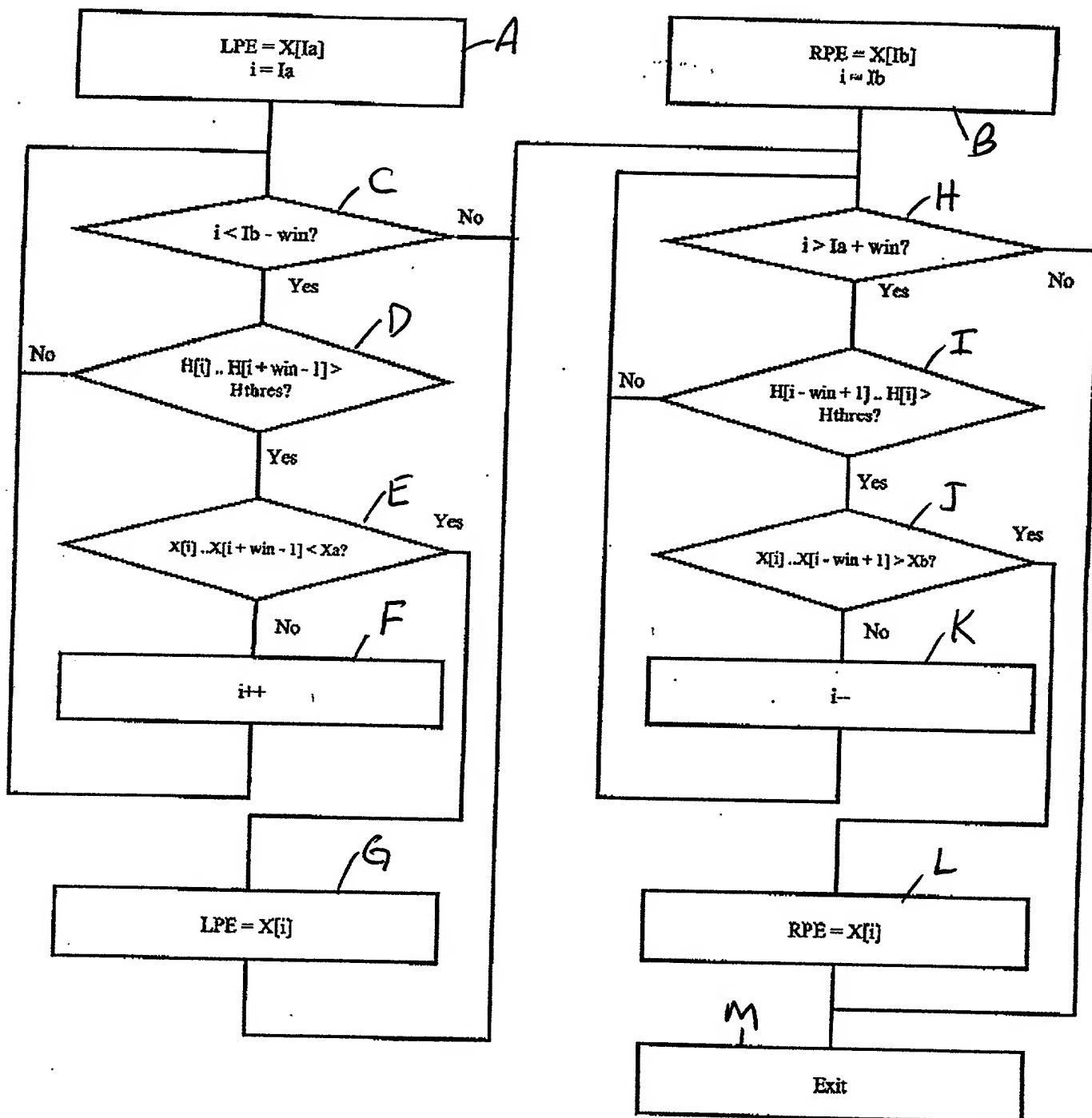


Fig. 15

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LDIP Real Time Package Edge Detection



Xa = location of belt left edge; Xb = location of belt right edge
 Ia = belt edge edge pixel; Ib = belt right edge pixel
 LPE = Left package edge; RPE = Right package edge
 $H[]$ = Pixel height array; $X[]$ = Pixel location array
 win = package detection window

FIG. 16

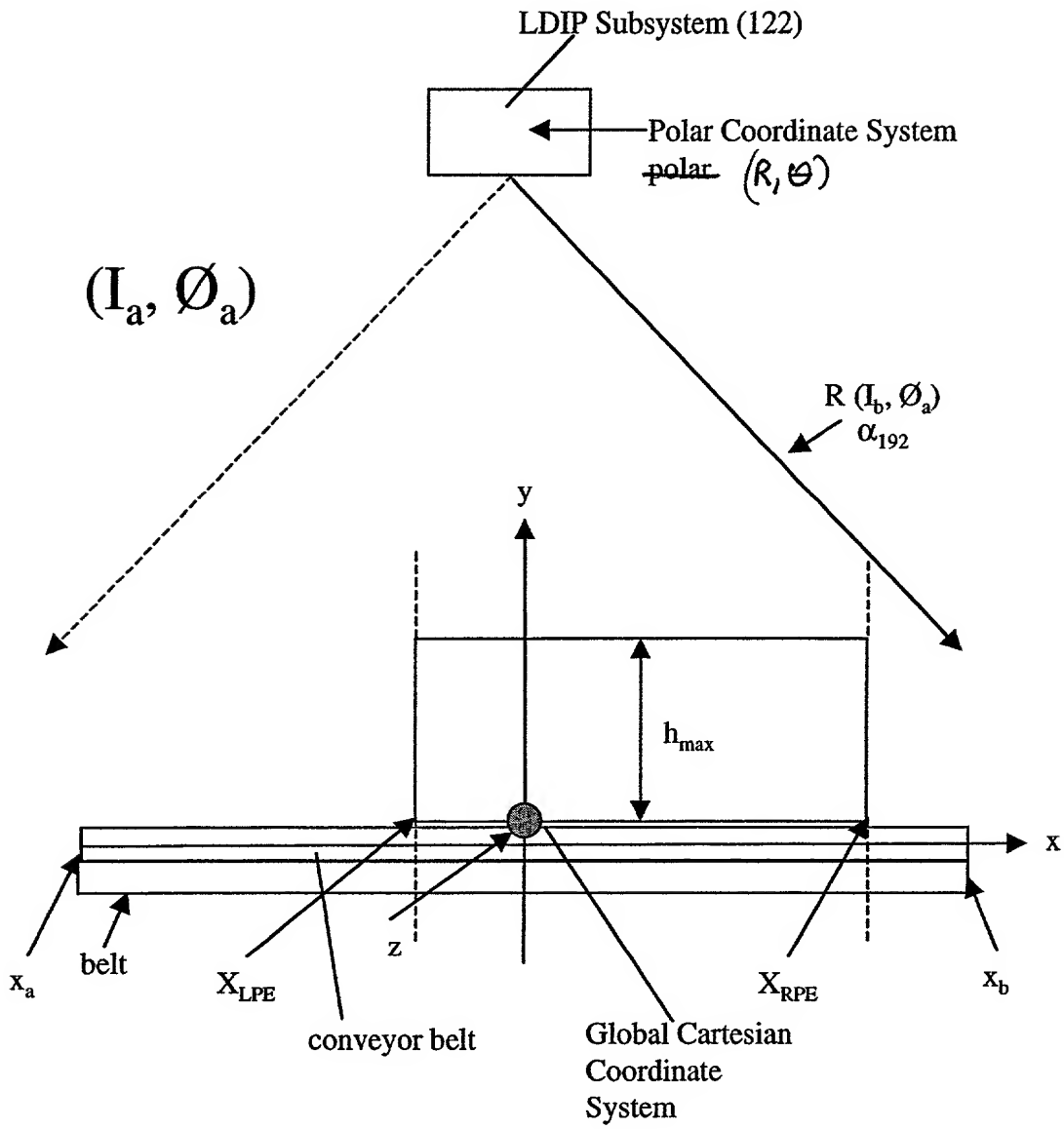


Fig. 17

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INFORMATION MEASURED AT SCAN ANGLES BEFORE COORDINATE TRANSFORMS

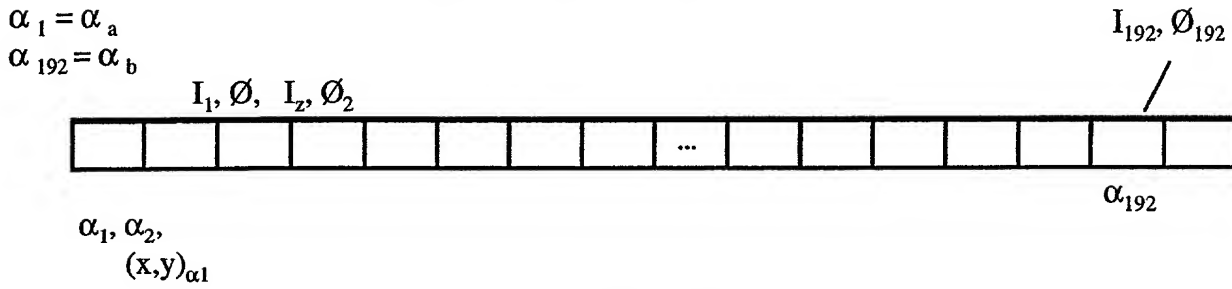


Fig. 17A

RANGE AND POLAR ANGLE MEASURES TAKEN AT SCAN ANGLE α BEFORE COORDINATE TRANSFORMS



Fig. 17B

MEASURED PACKAGE HEIGHT AND POSITION VALUES AFTER COORDINATE TRANSFORMS

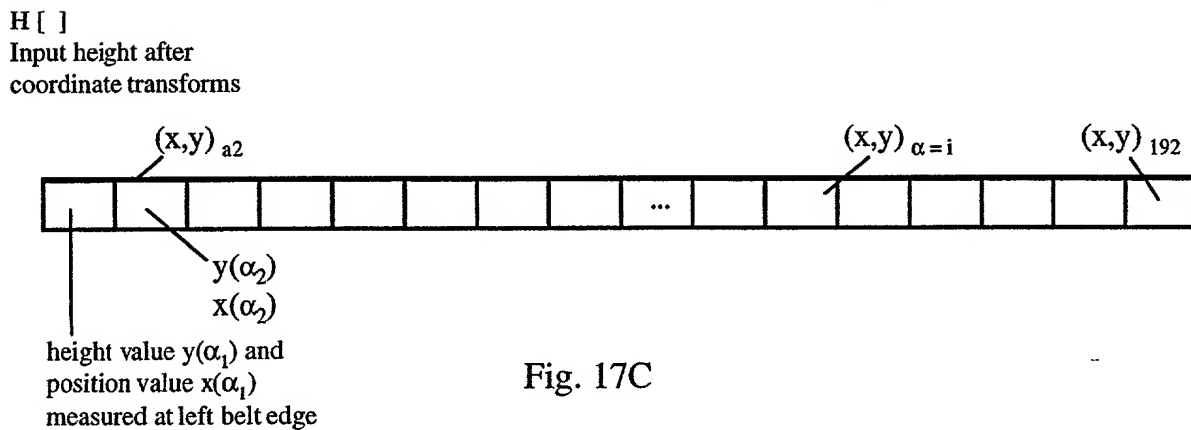


Fig. 17C

CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE CAMERA CONTROL SUBSYSTEM OF EACH OBJECT ATTRIBUTE ACQUISITION AND ANALYSIS SYSTEM

560

Start

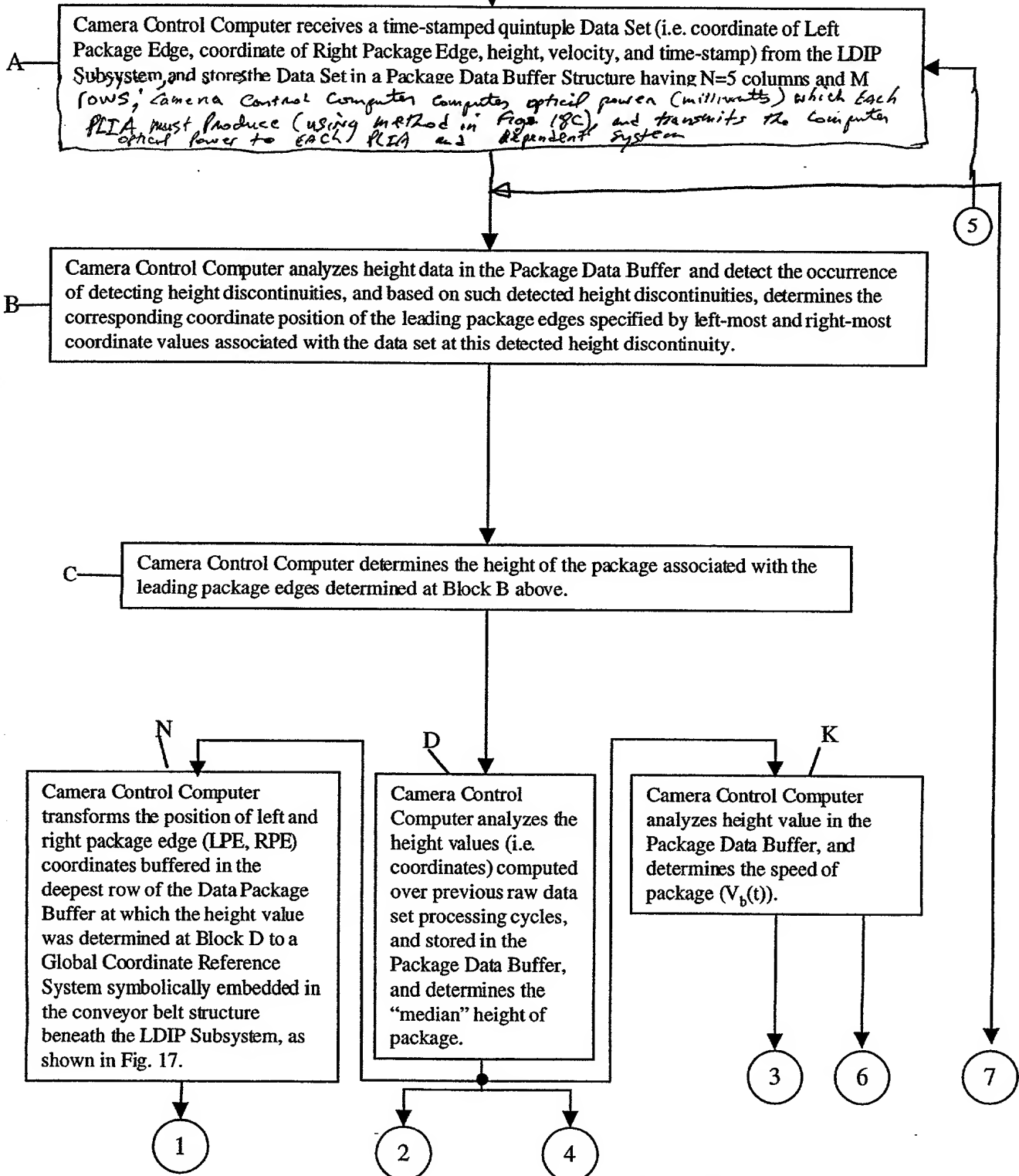


Fig. 18A

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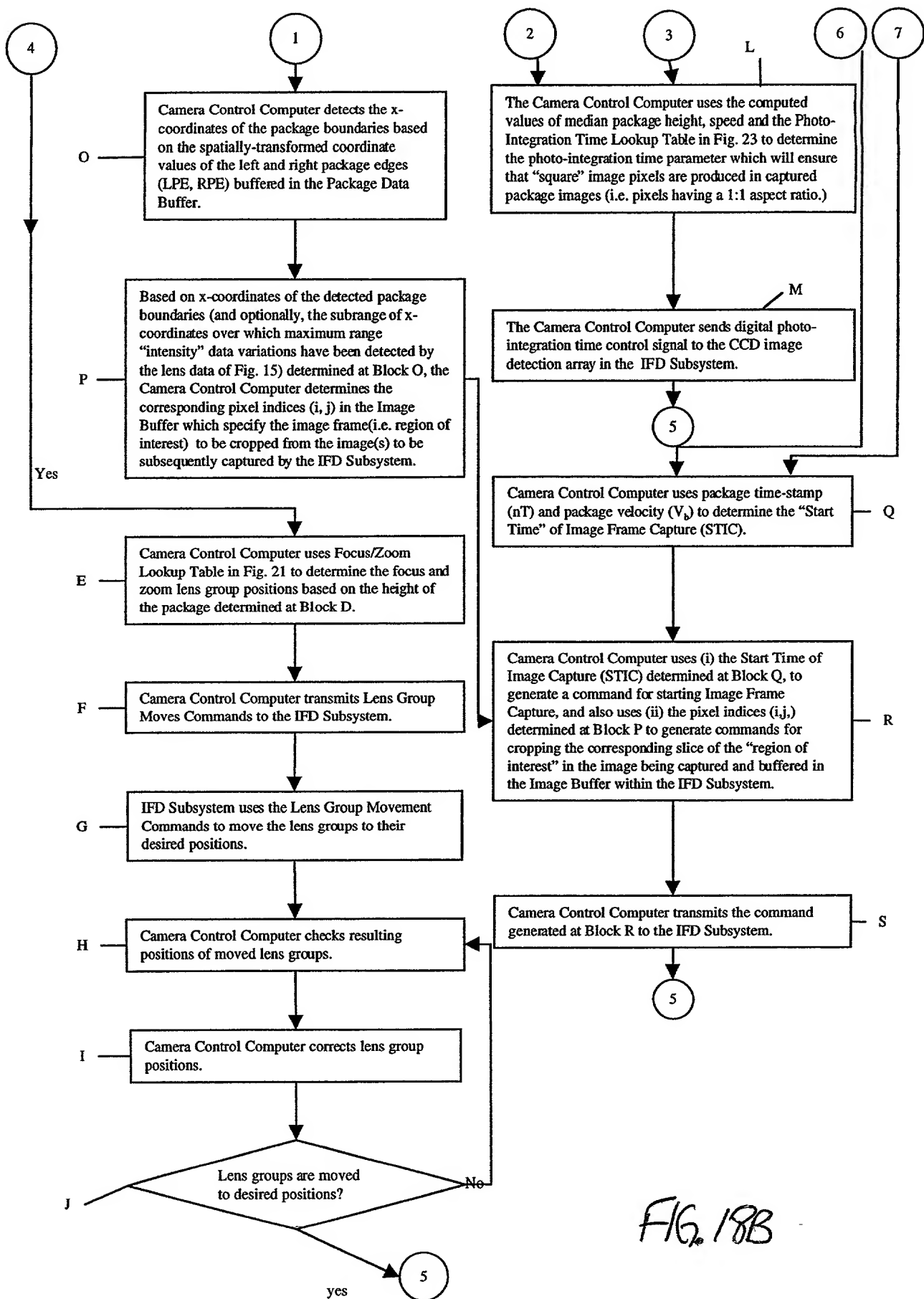


FIG. 18B

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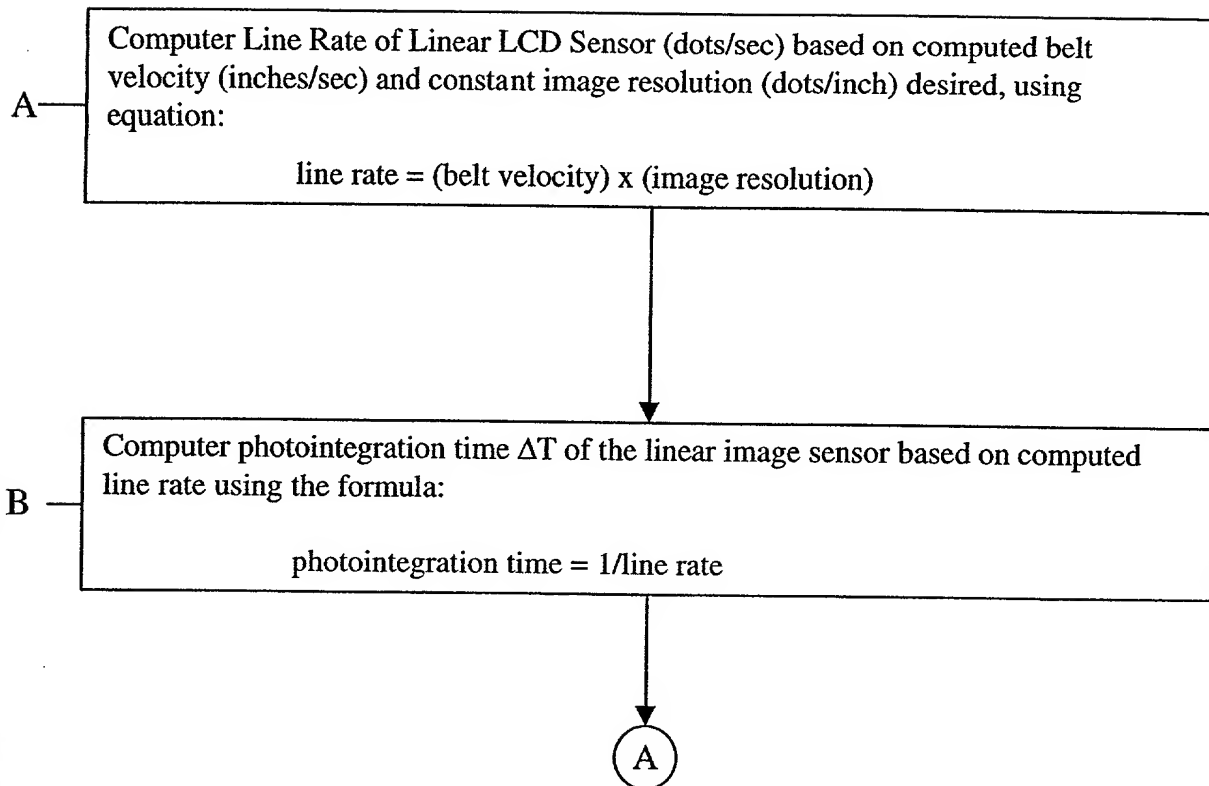


Fig. 18C1

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Compute optical power (milliwatts) of each PLIA based on computed photointegration time (ΔT) using the following formula:

$$\text{optical power of LD (milliwatts)} = \frac{\text{constant}}{\text{photointegration time } \Delta T}$$

Fig. 18C2

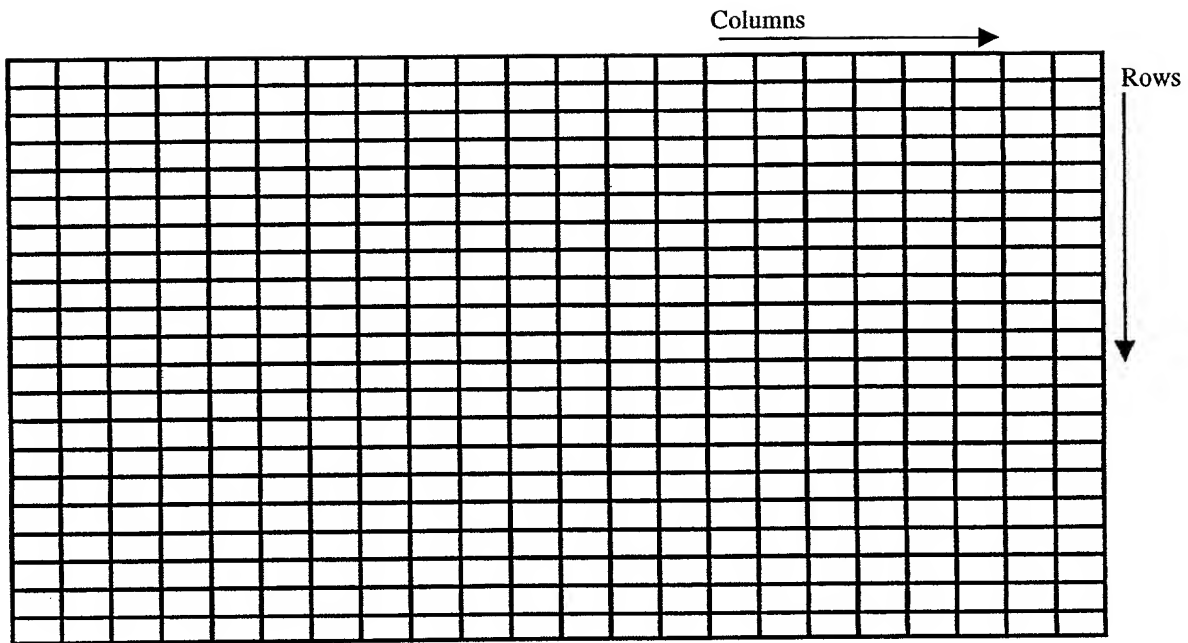
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X coordinate subrange where
maximum range "intensity"
variations have been detected

Left Package Edge (LDE)	Package Height (h)	Right Package Edge (RPE)	Package Velocity	Time-stamp (nT)	
					Row 1
					Row 2
					Row 3
					Row 4
					Row 5
					Row M

Package Data Buffer (FIFO)

Fig. 19



Camera Pixel Data Buffer
pixel indices (i,j)

Fig. 20

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Zoom and Focus Lens Group Position
Look-up Table

Distance from Camera H (mm)	Zoom group distance (mm) Y (Zoom)	Focus group distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.44003358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883615

(use interpolation techniques for working distances between listed points in table)

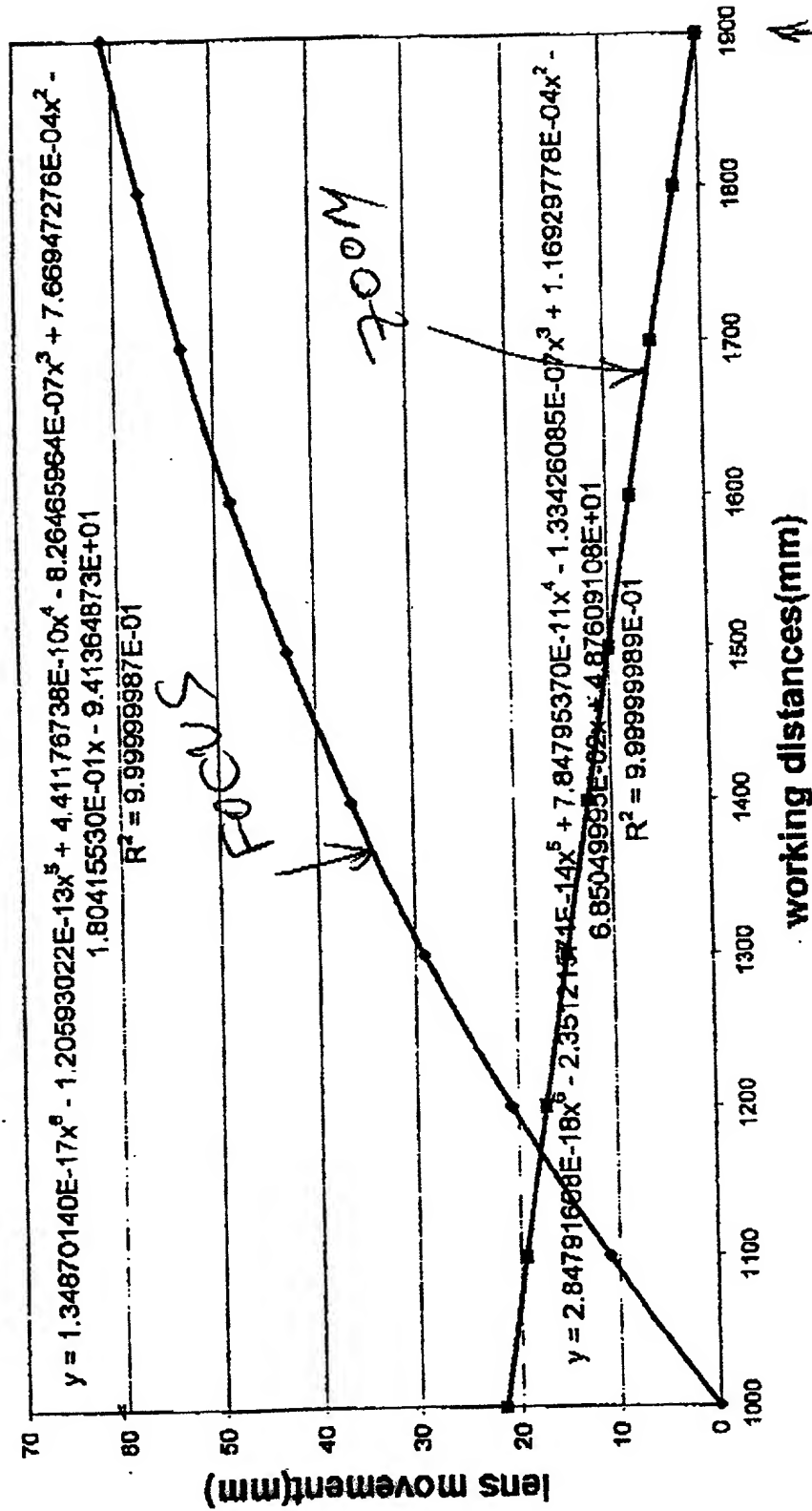
FIG. 21

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* Note: The feed distance & zoom (eff. focal length) of camera lens are coupled (interdependent) in this camera has a fixed aperture F5.6

Focus and Zoom lens movement vs. working distances



↑ (inches) 36 above conveyor belt

← package height above conveyor

conveyor-belt surface

FIG. 22

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600 feet per minute
(FPM)

Photo-Integration Time Look-up Table

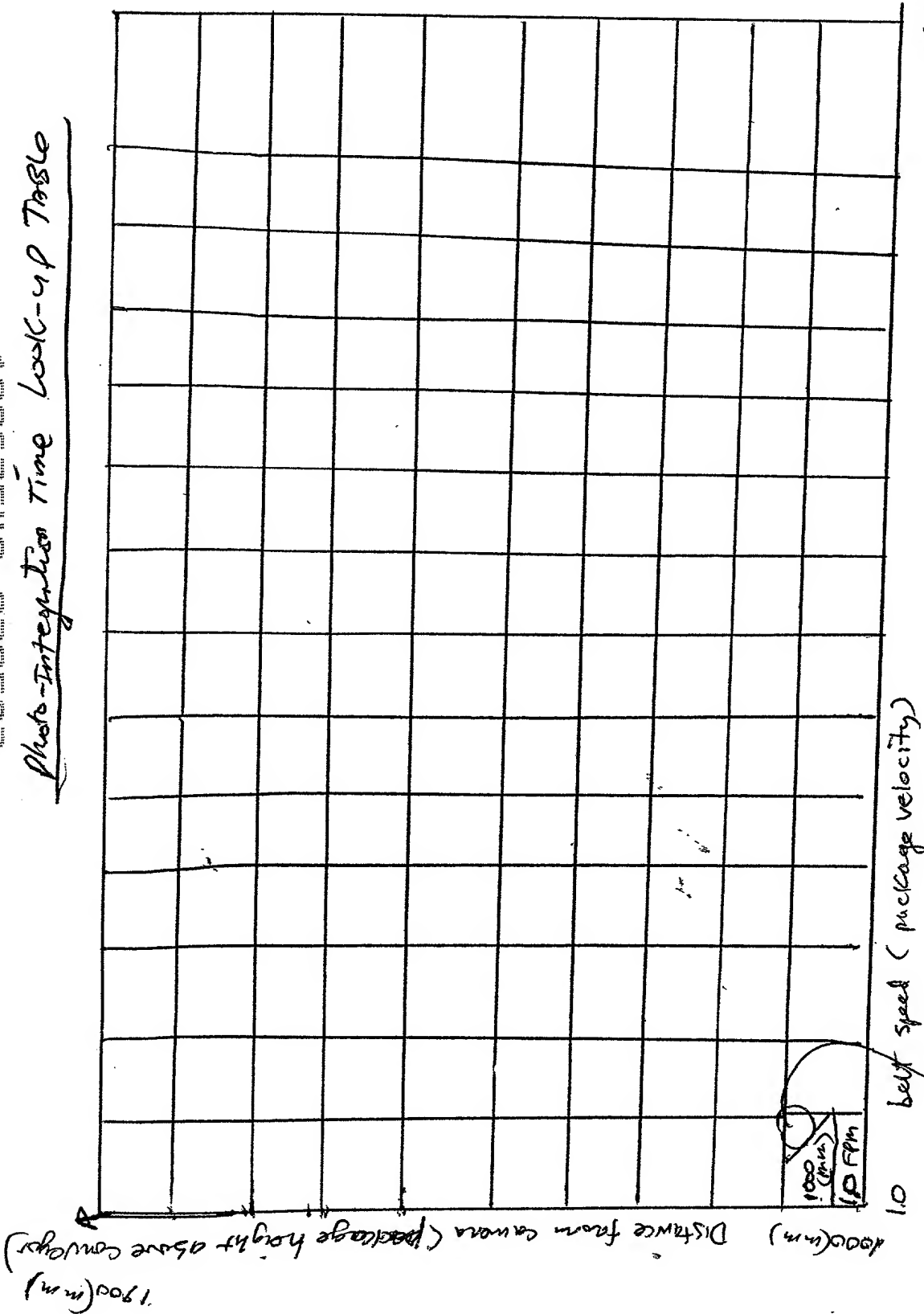


FIG. 23

Photo-Integration
Time value that
Ensures square image pixels
(1:1 aspect ratio)

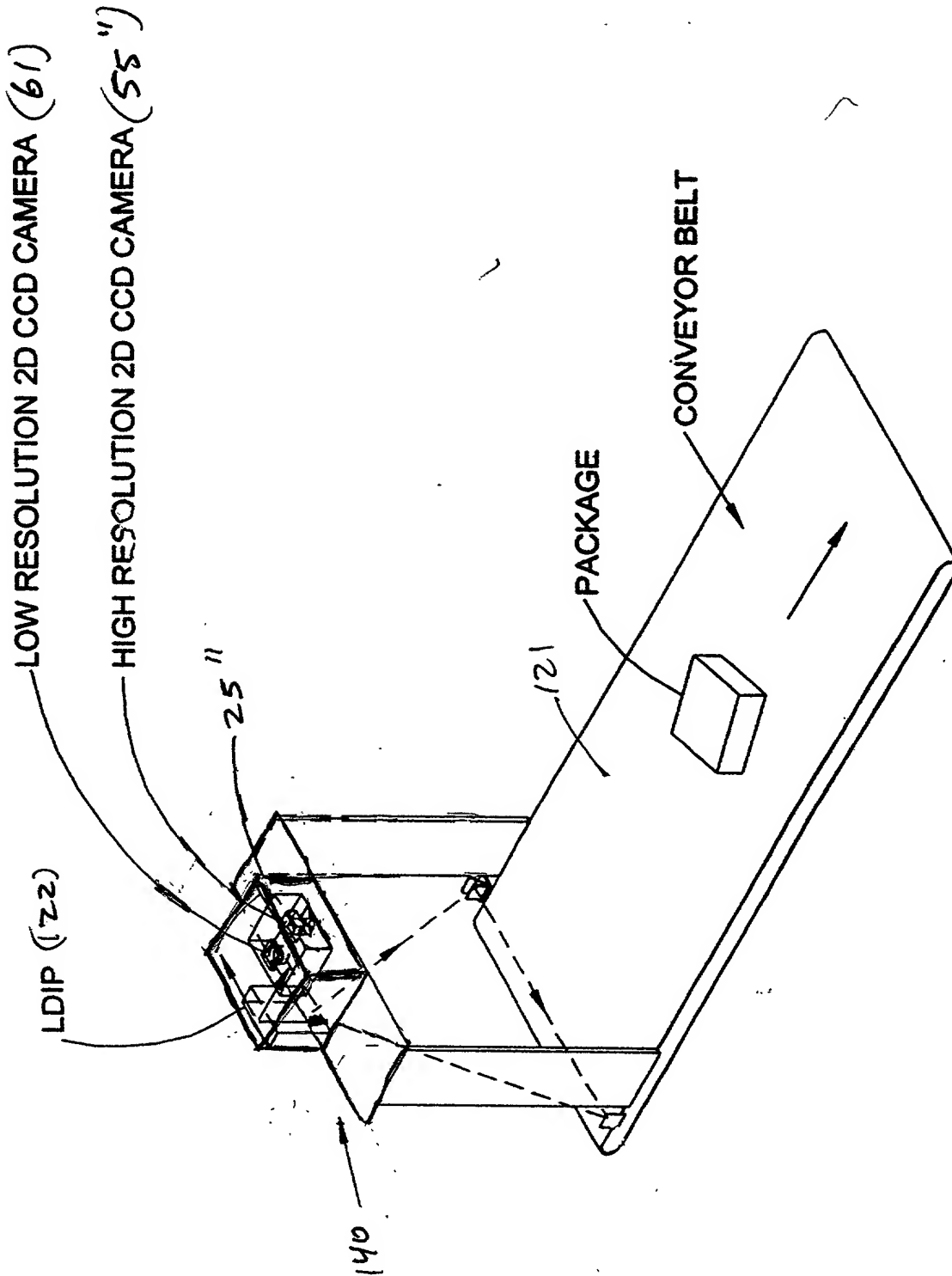


FIG 24



FIG 25

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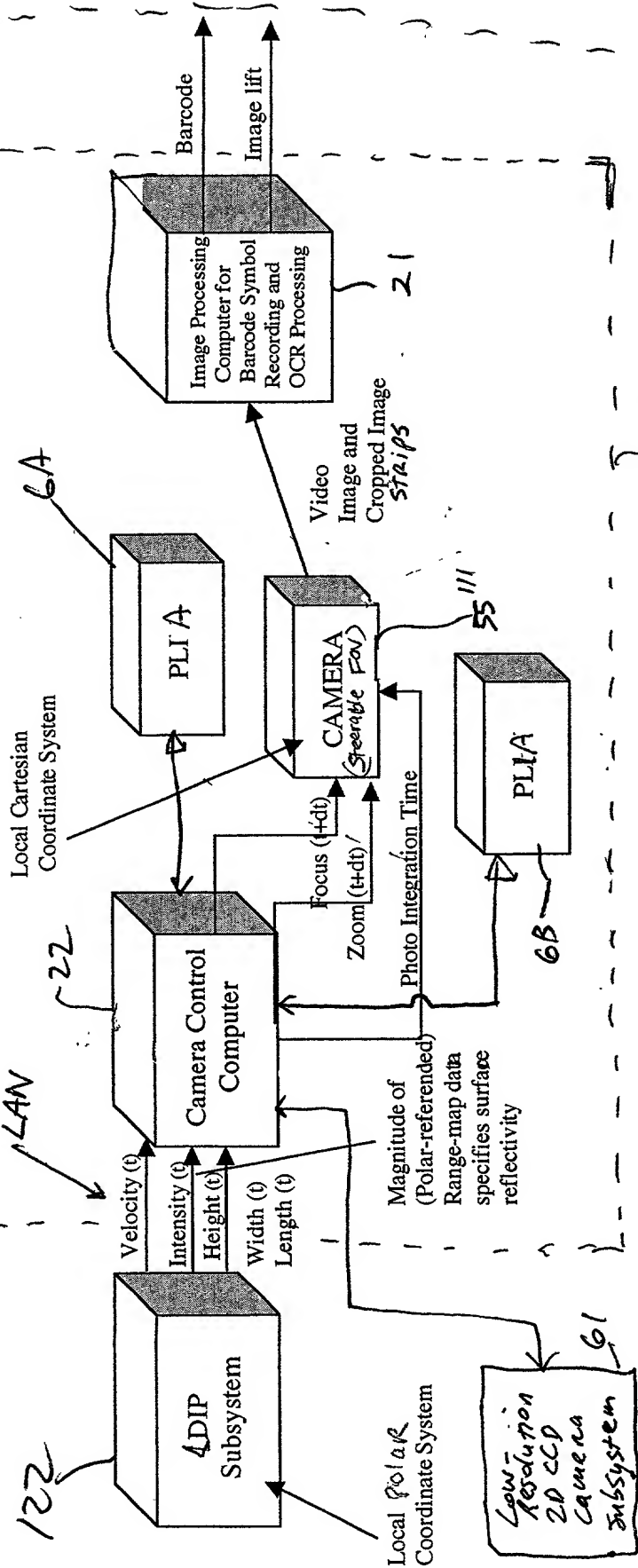
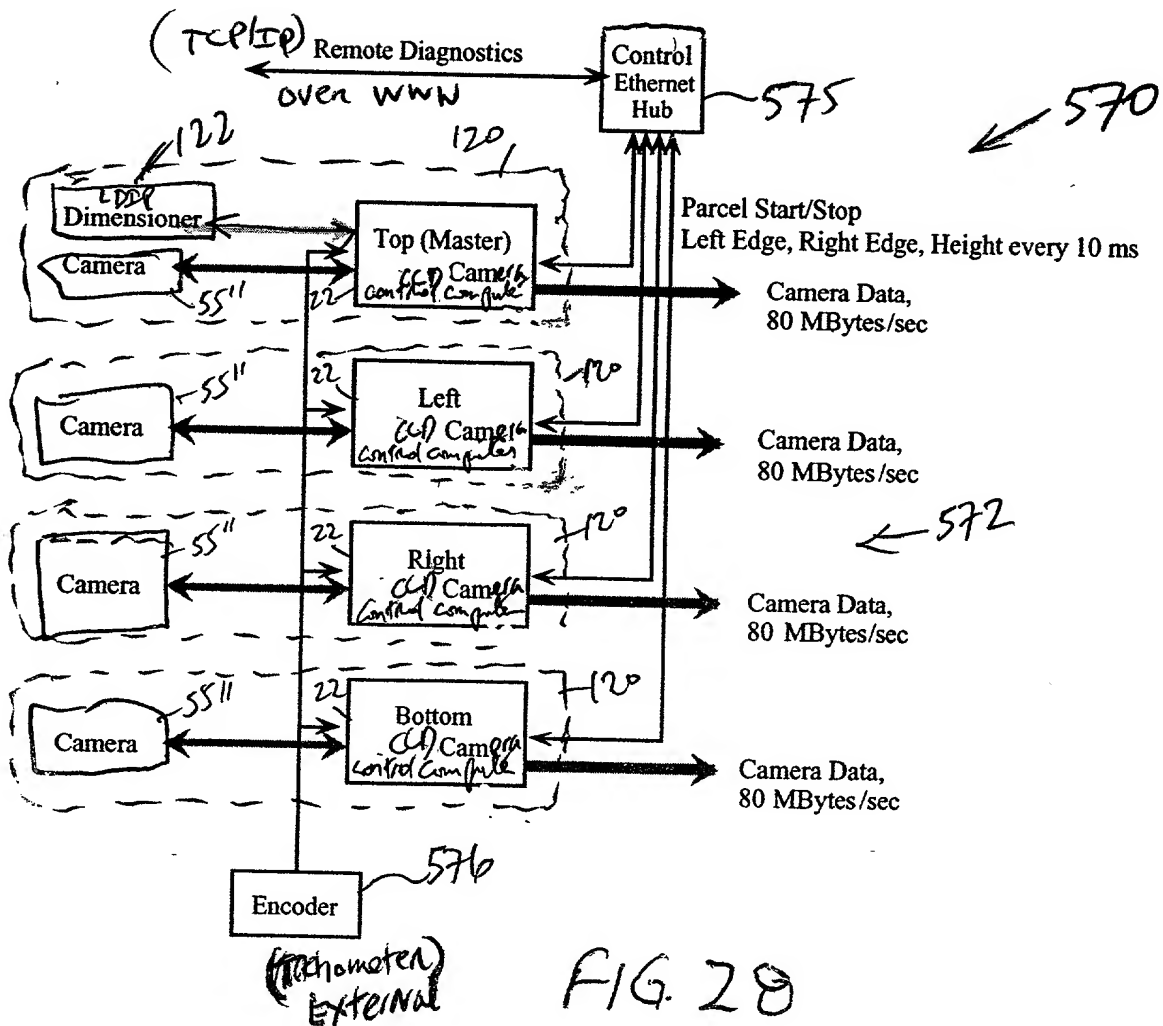
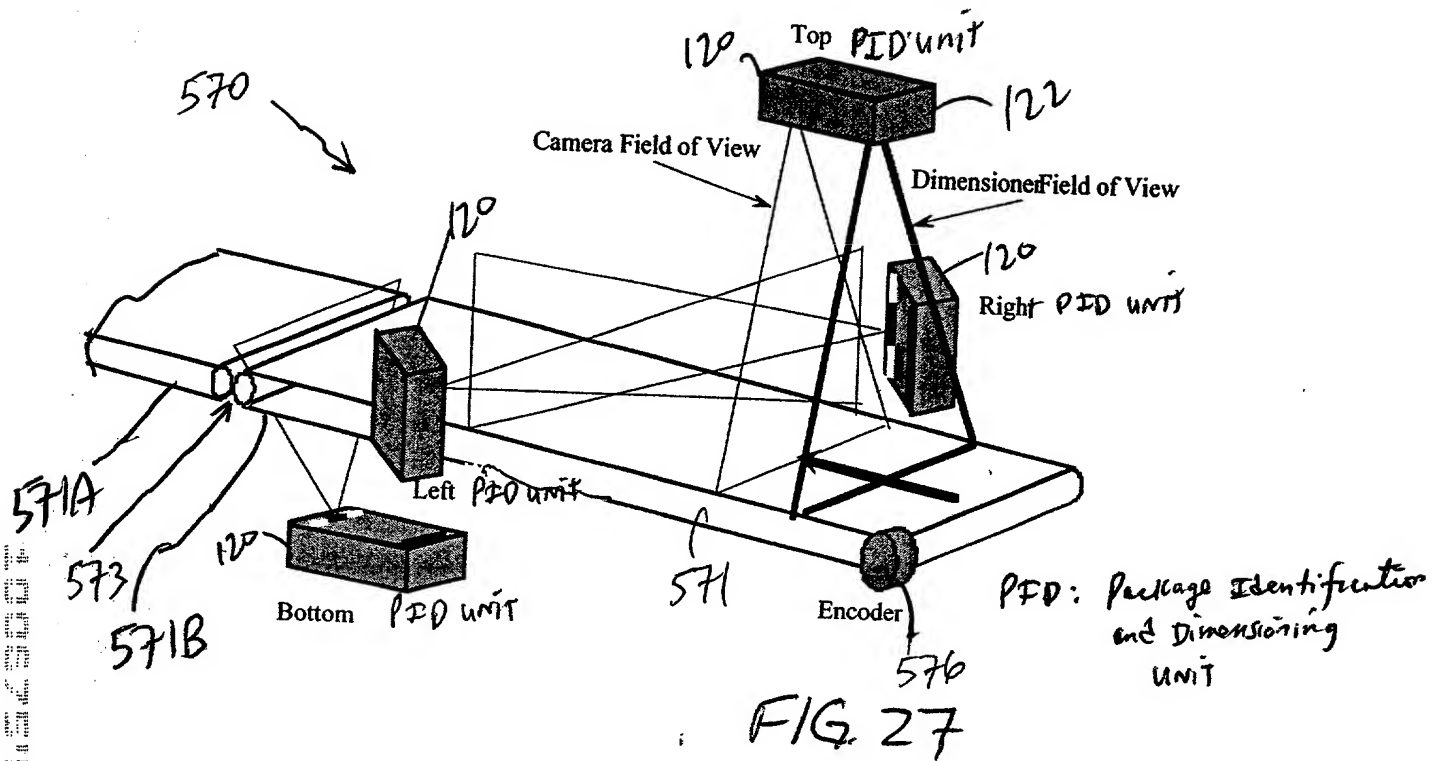
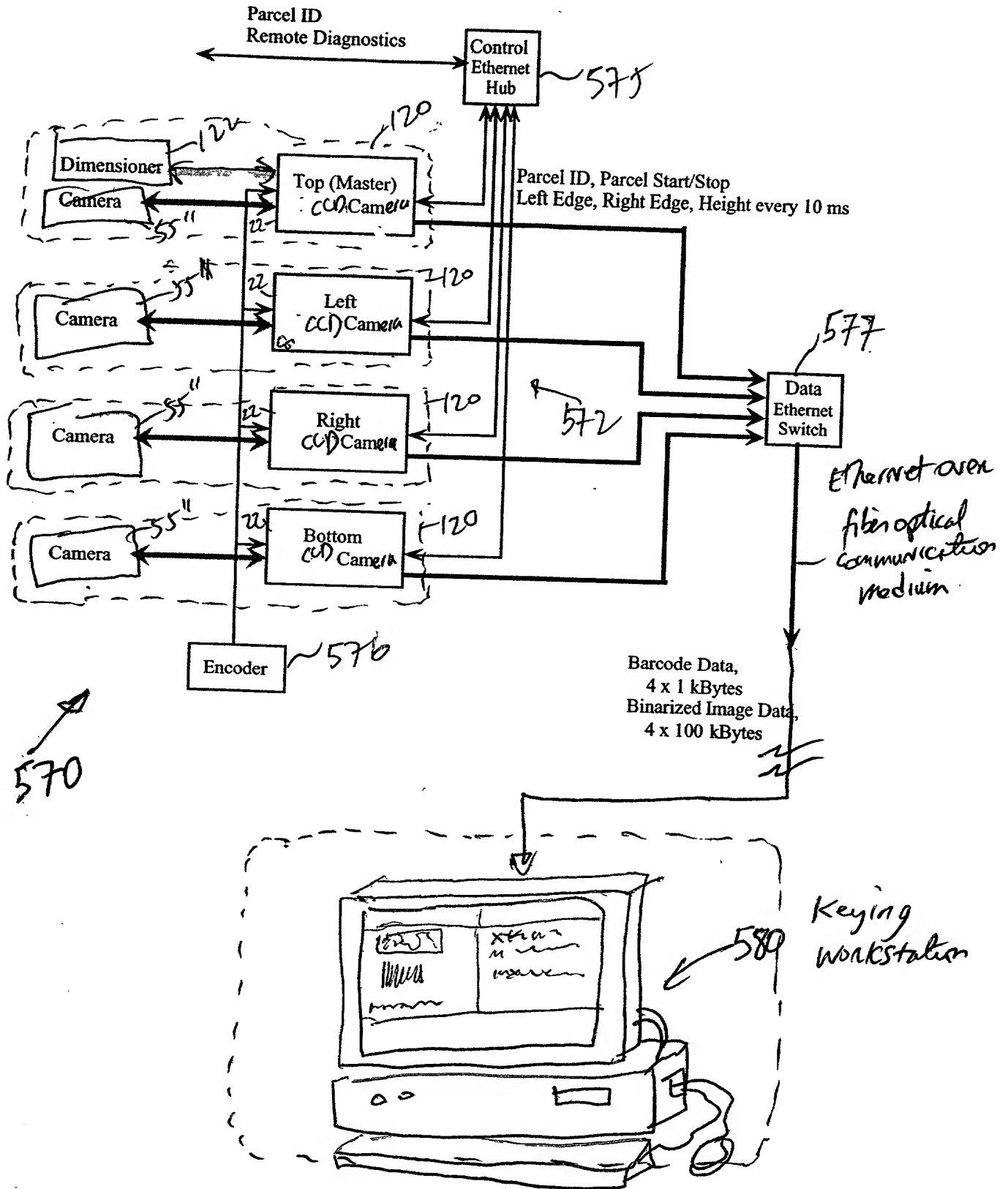


FIG. 26





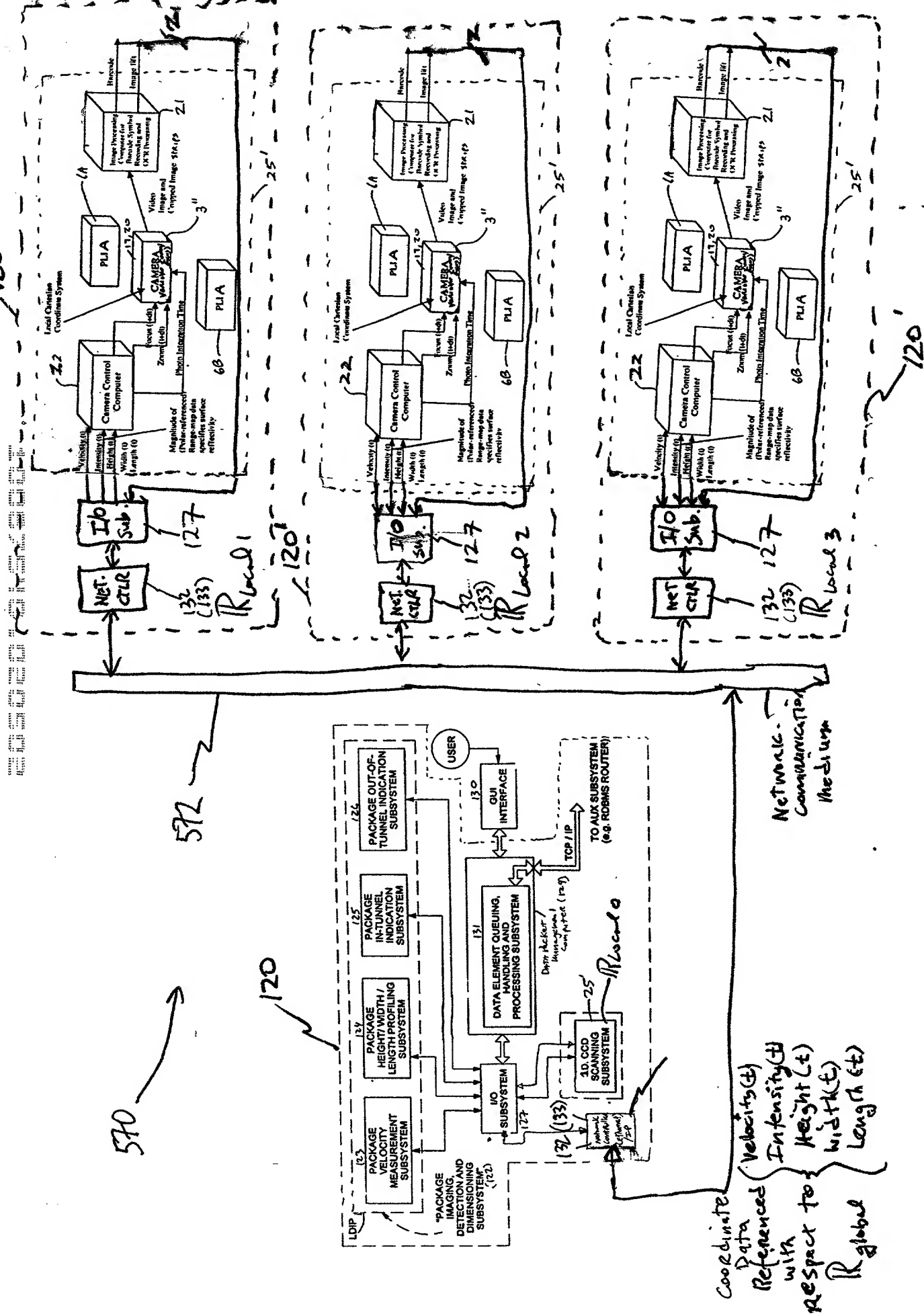


FIG 30

CCD Camera-Based Tunnel System
Employing Package Coordinate Data
Driven Method of Automatic Camera
Zoom and Focus Control

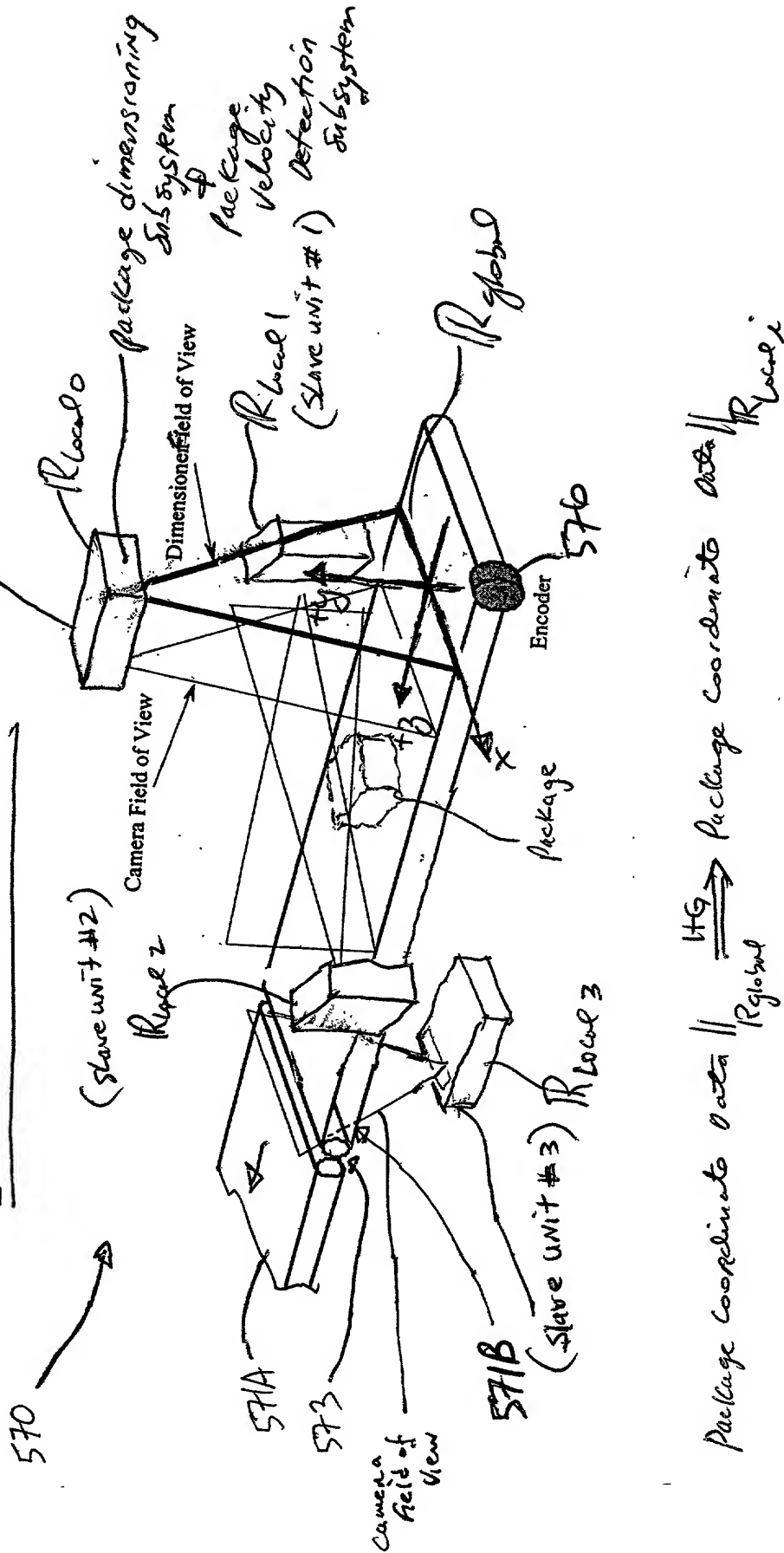


FIG. 31

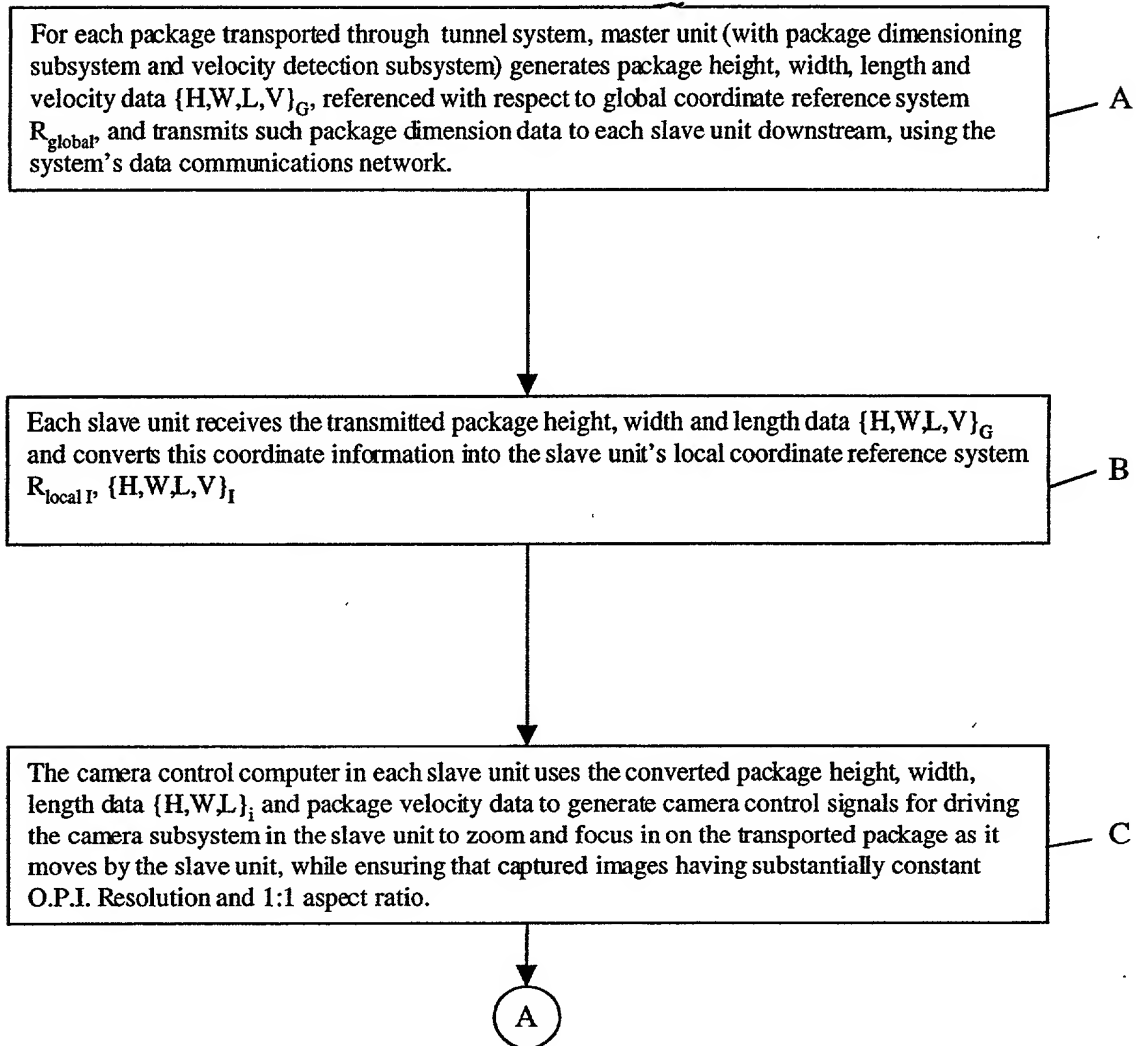


FIG. 32A



Each slave unit captures images acquired by its intelligently controlled camera subsystem, buffers the same, and processes the images to decode bar code symbol identifiers represented in said images, and/or to perform optical character recognition (OCR) thereupon.

D

The slave unit which decodes a bar code symbol in a processed image automatically transmits a package identification data element (containing symbol character data representative of the decoded bar code symbol) to the master unit (or other designated system control unit employing data element management functionalities) for package data element processing.

E

Master unit time-stamps received package identification data element, places said data element in a data queue, and processes package identification data elements and time-stamped package dimension data elements in said queue to link each package identification data element with one said corresponding package dimension data element.

F

FIG. 32B

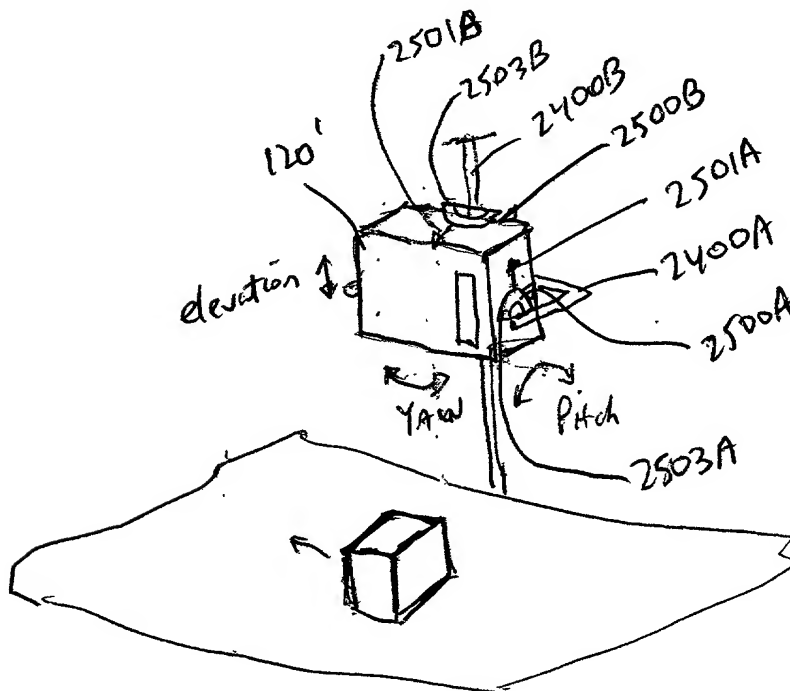
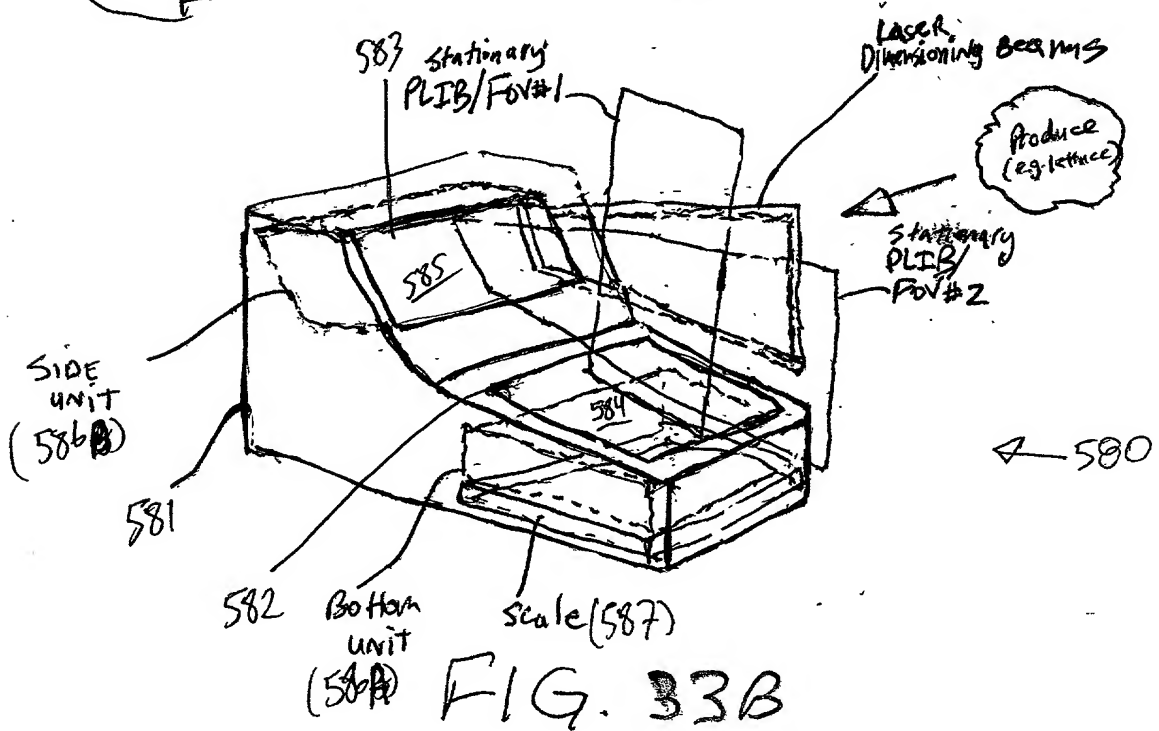
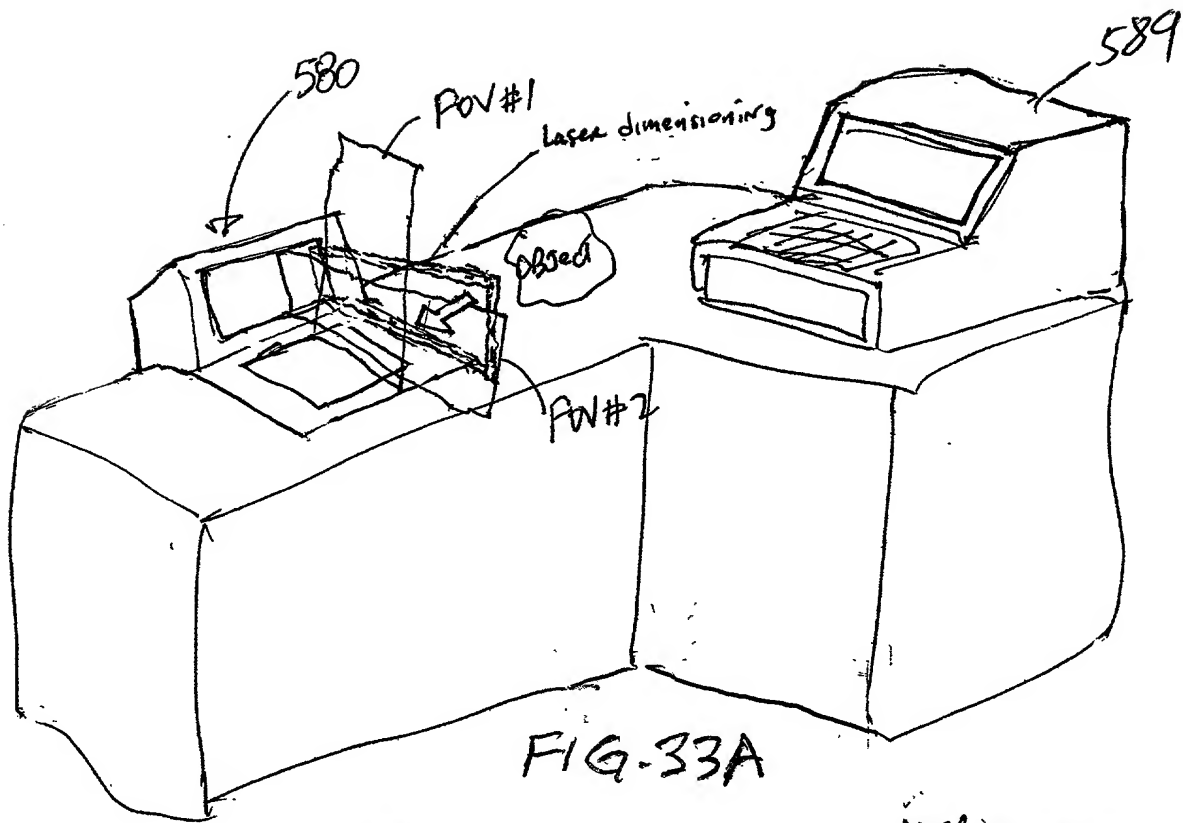


FIG. 31A

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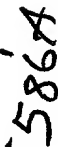


FIG. 33C

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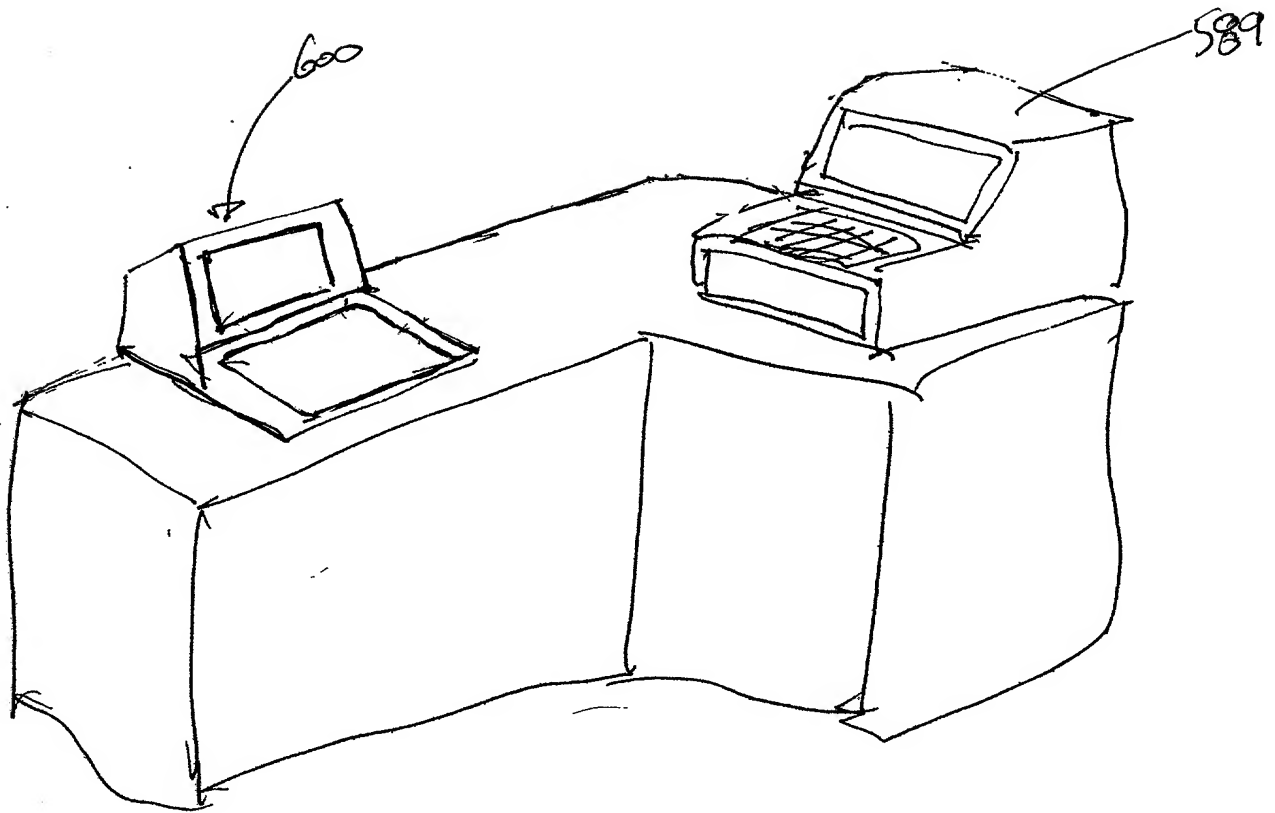


FIG. 34A

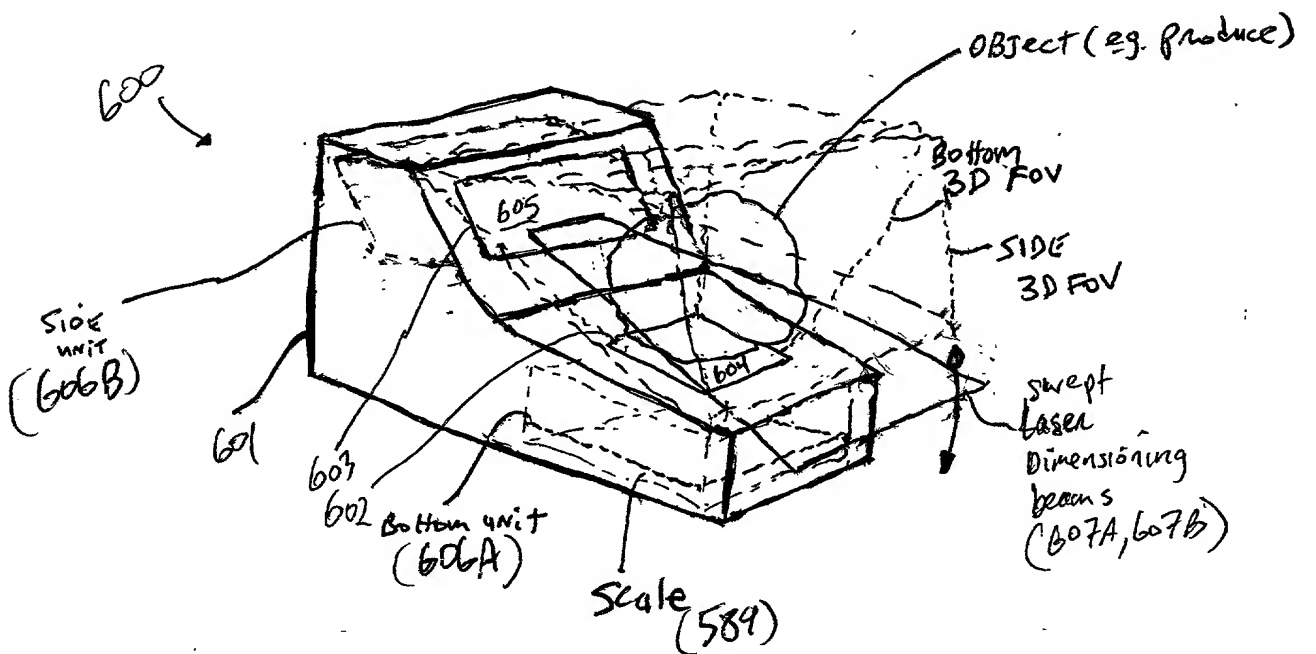


FIG. 34B

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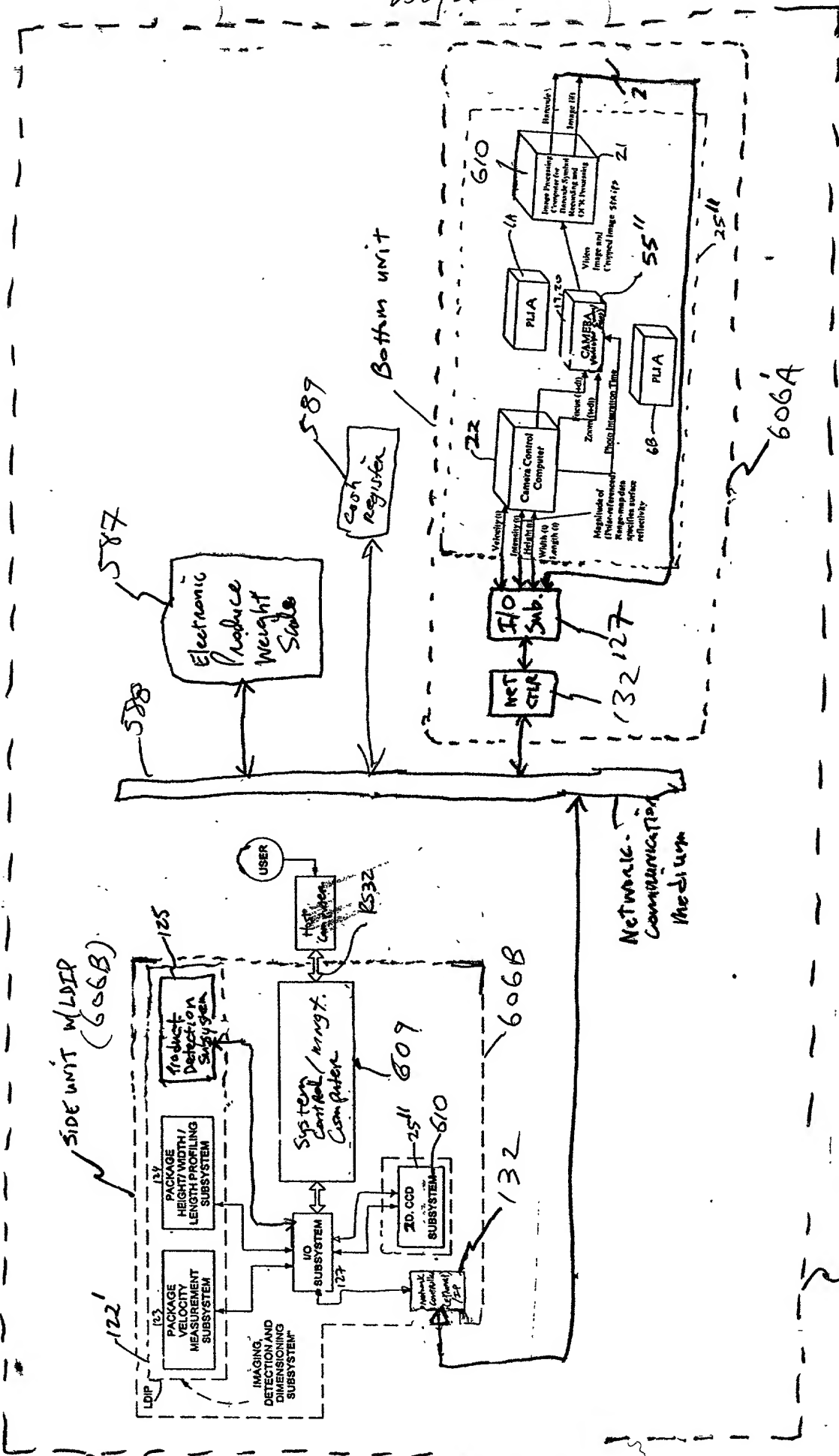
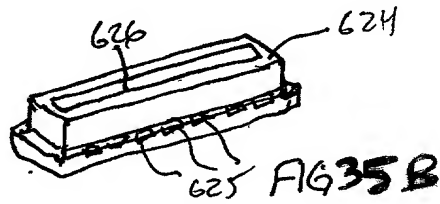
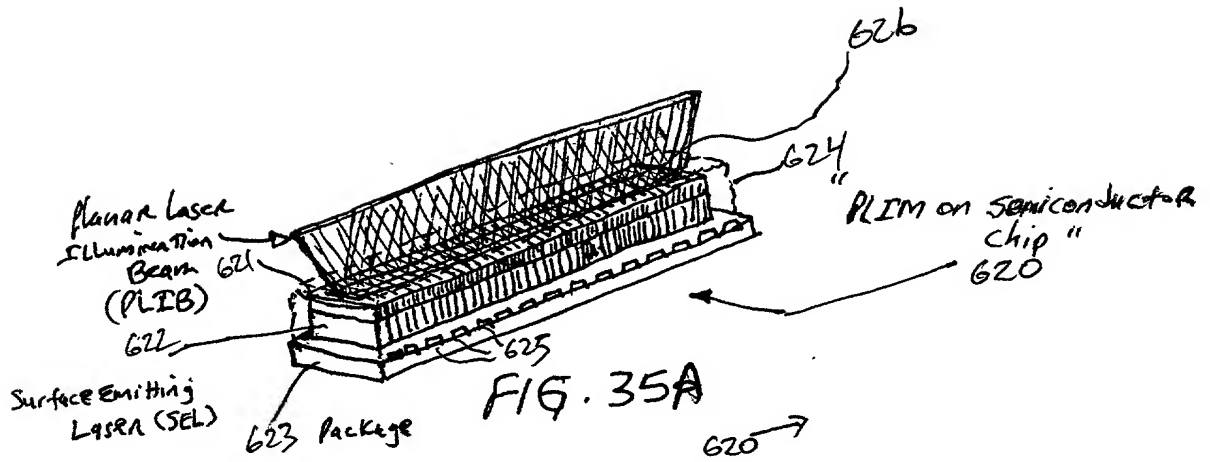
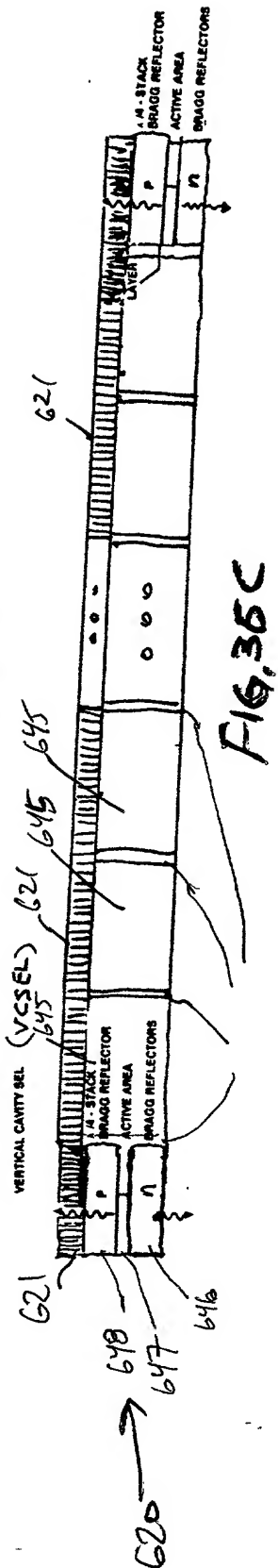
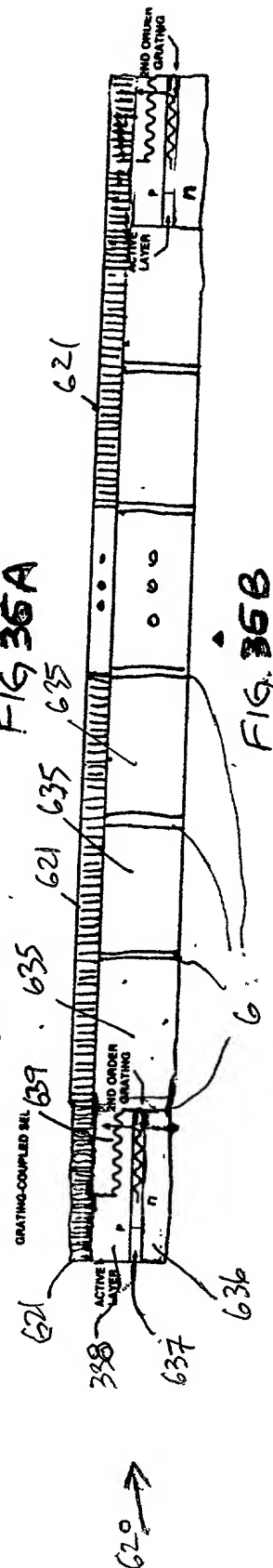
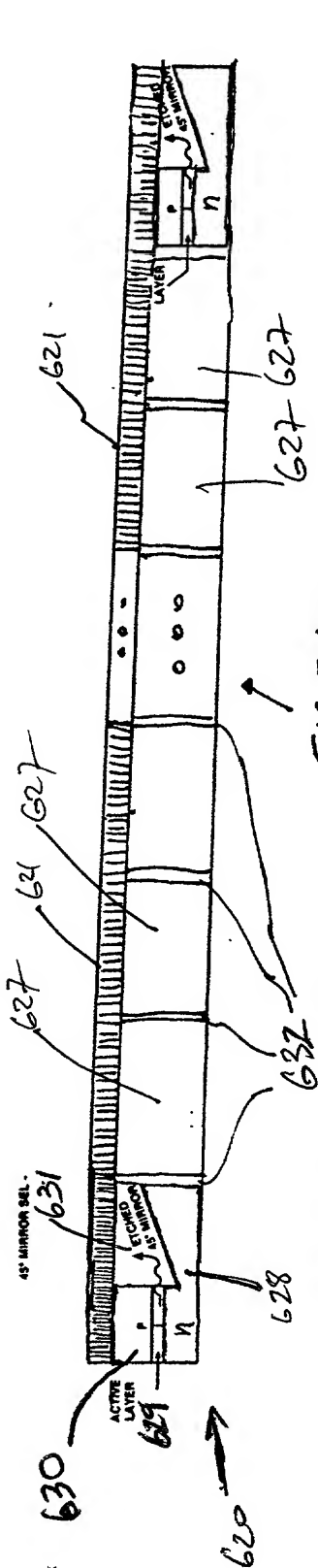


FIG. 34C





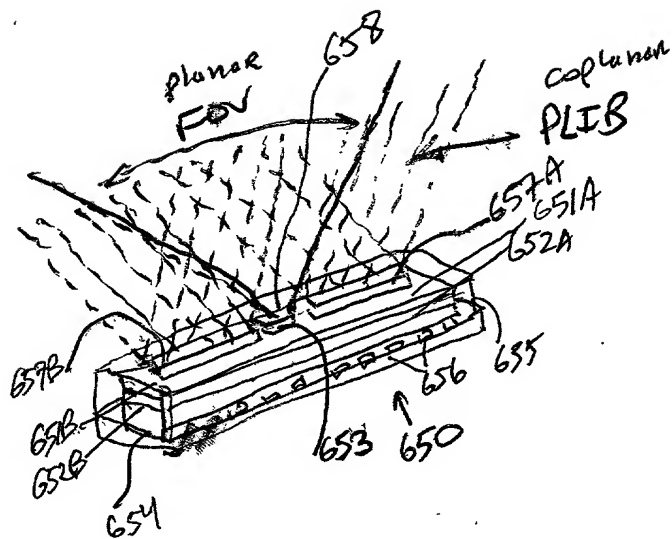


FIG. 37

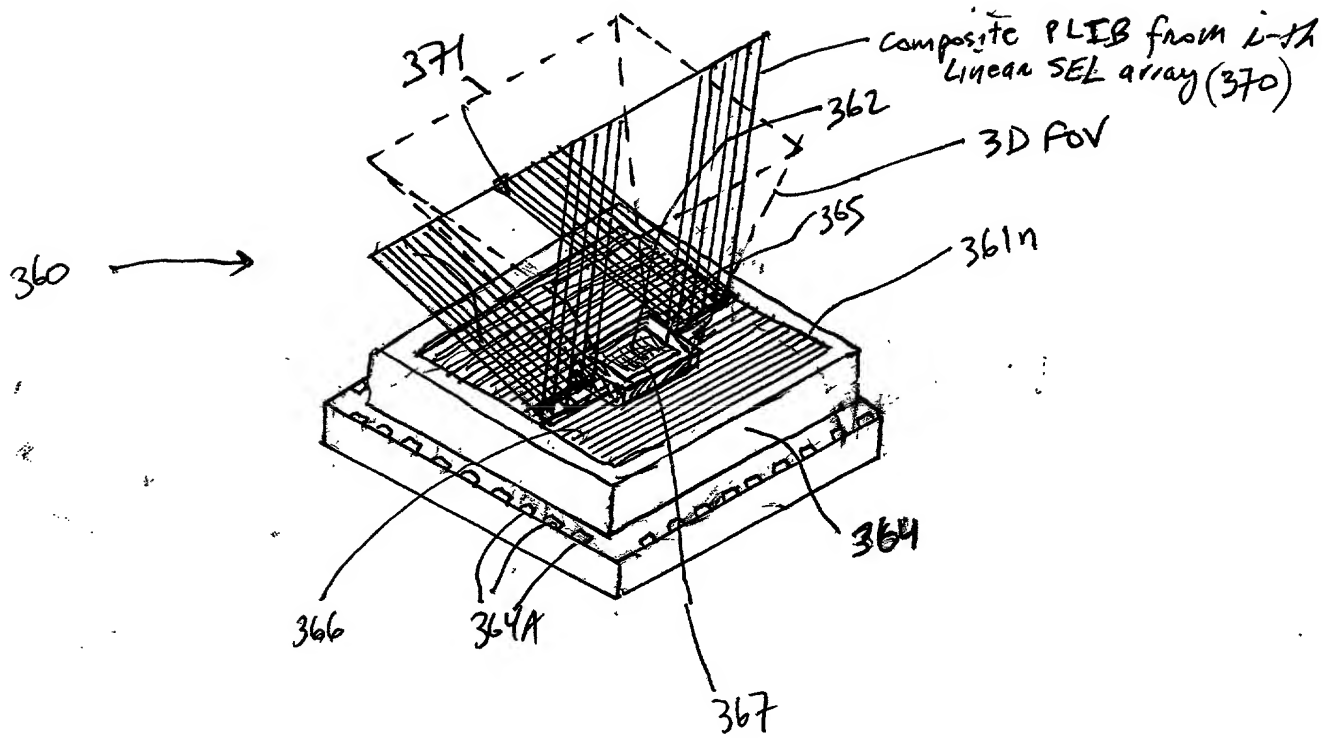


FIG. 38A

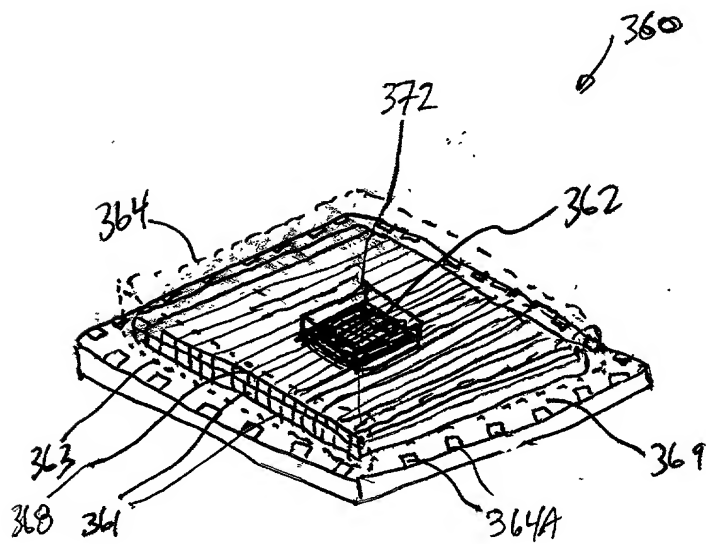


FIG. 38B

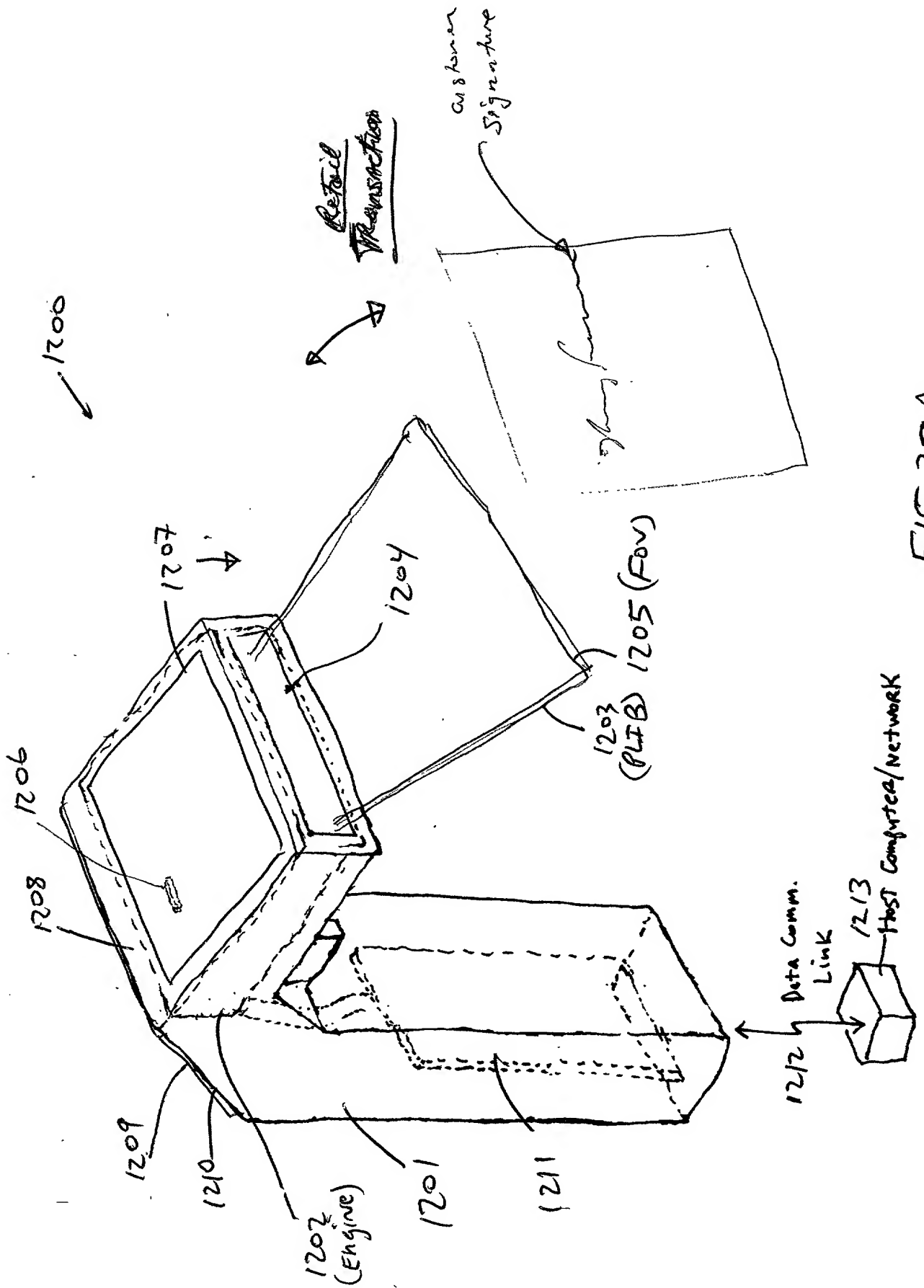


FIG. 39A

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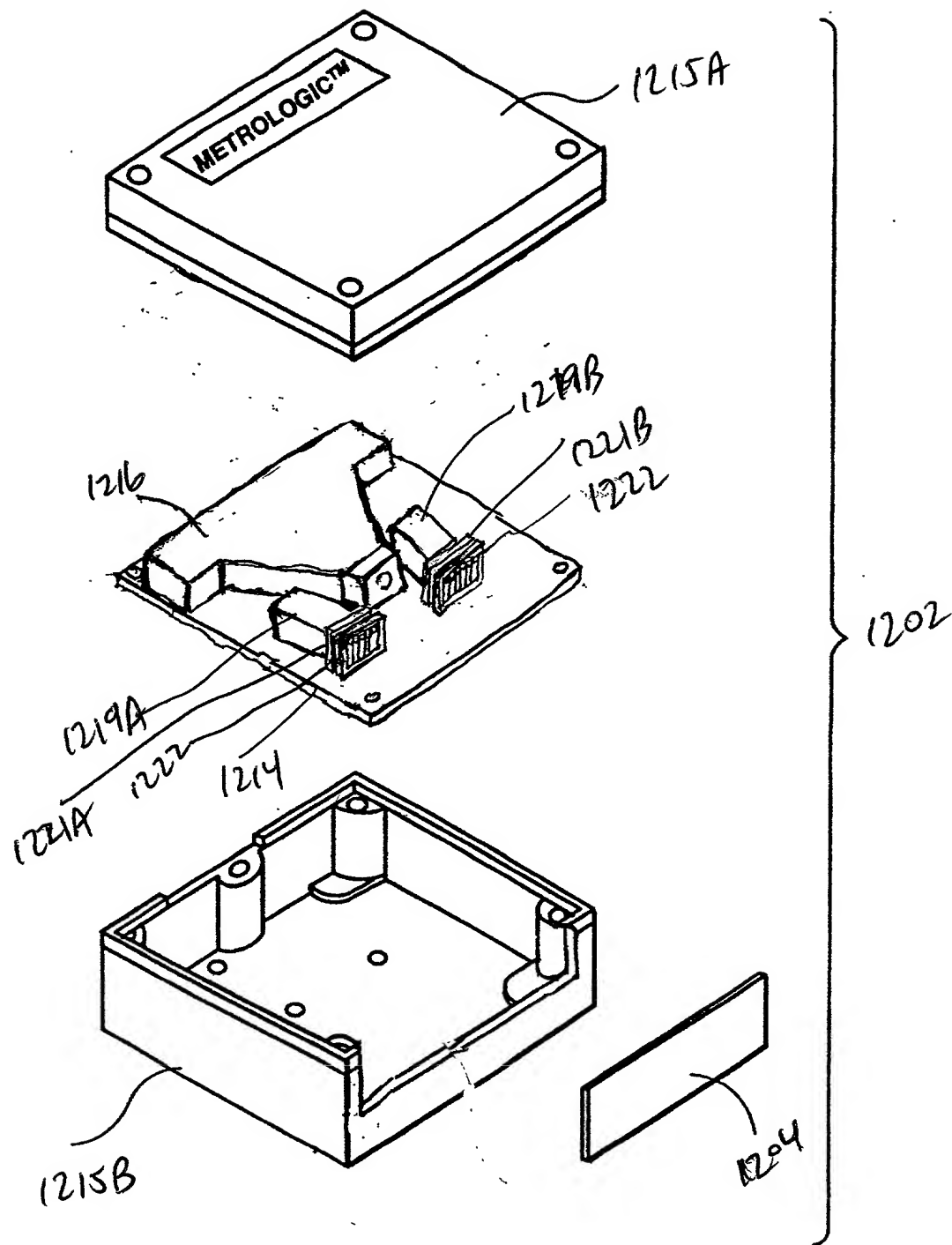


FIG. 39B

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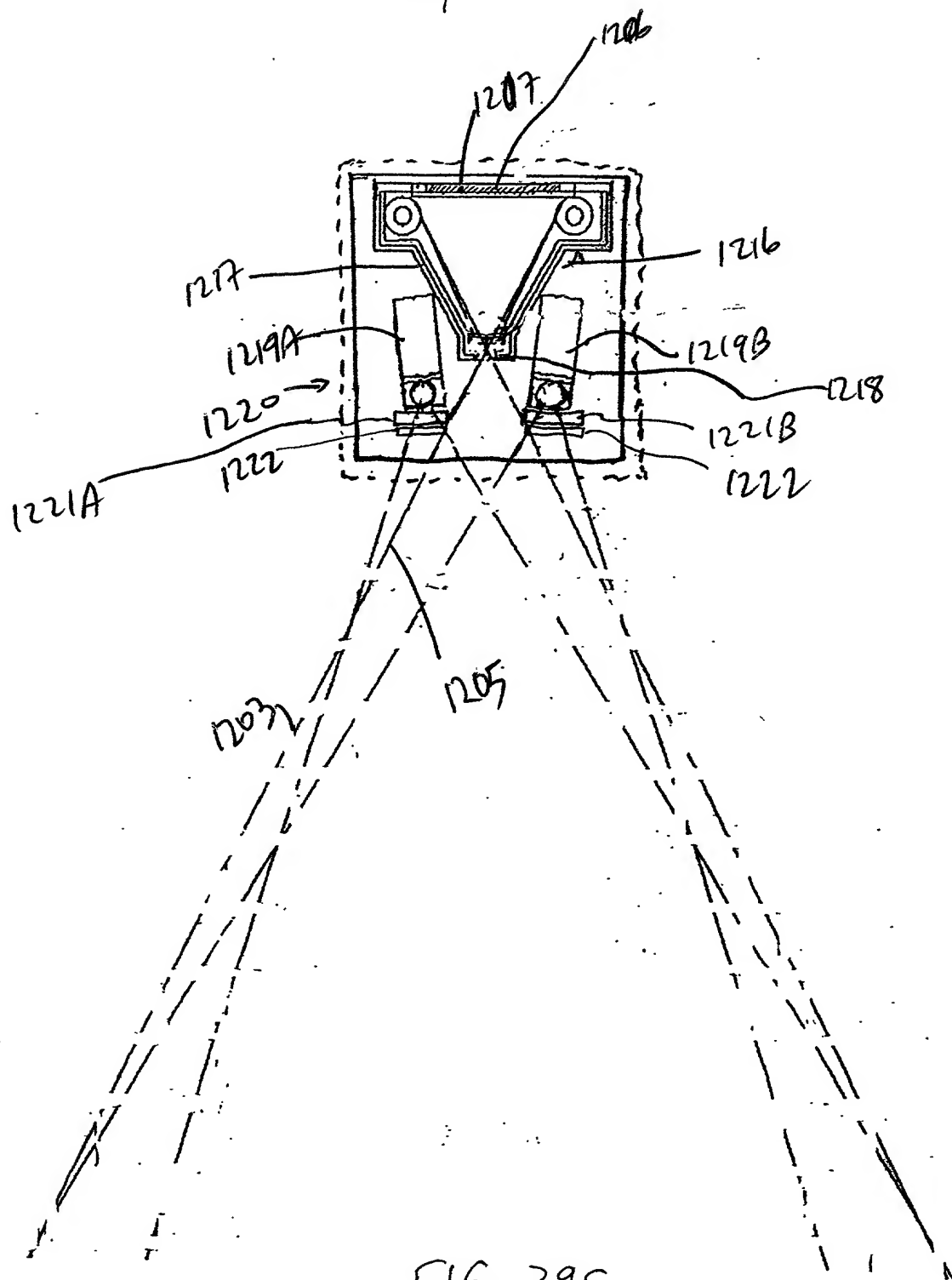


FIG. 39C

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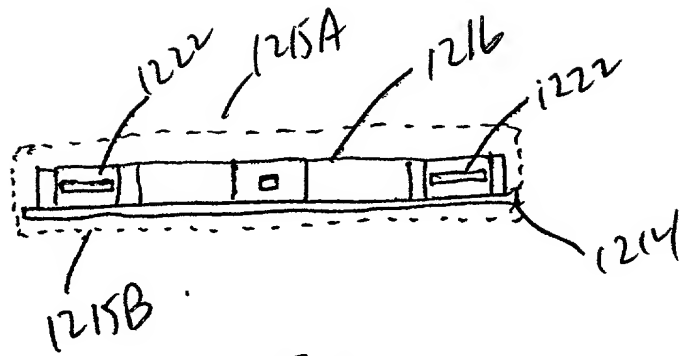


FIG. 39D

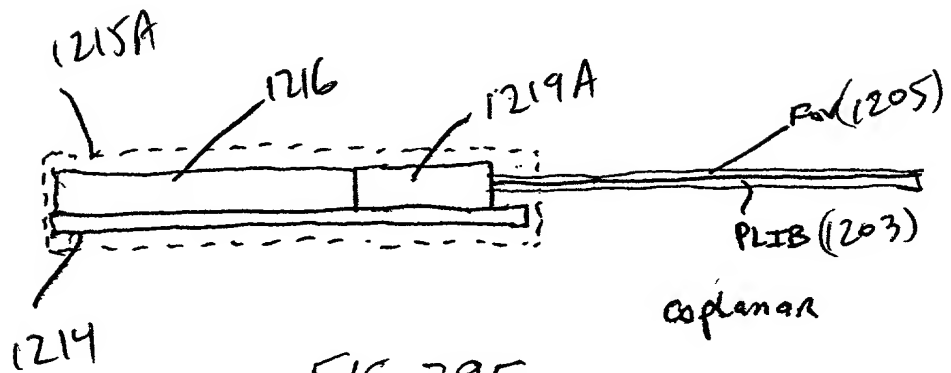


FIG. 39E

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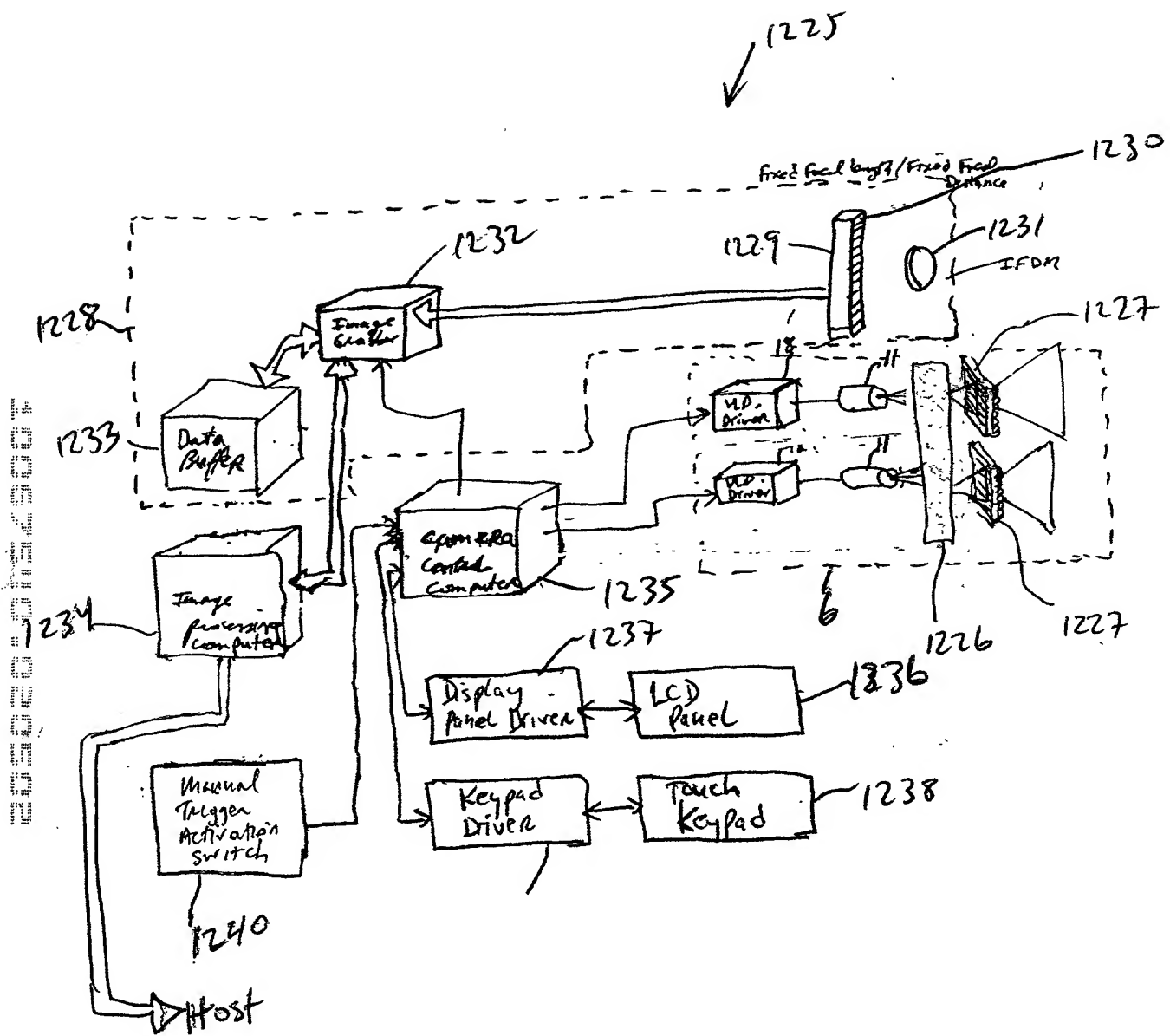


FIG. 40A1

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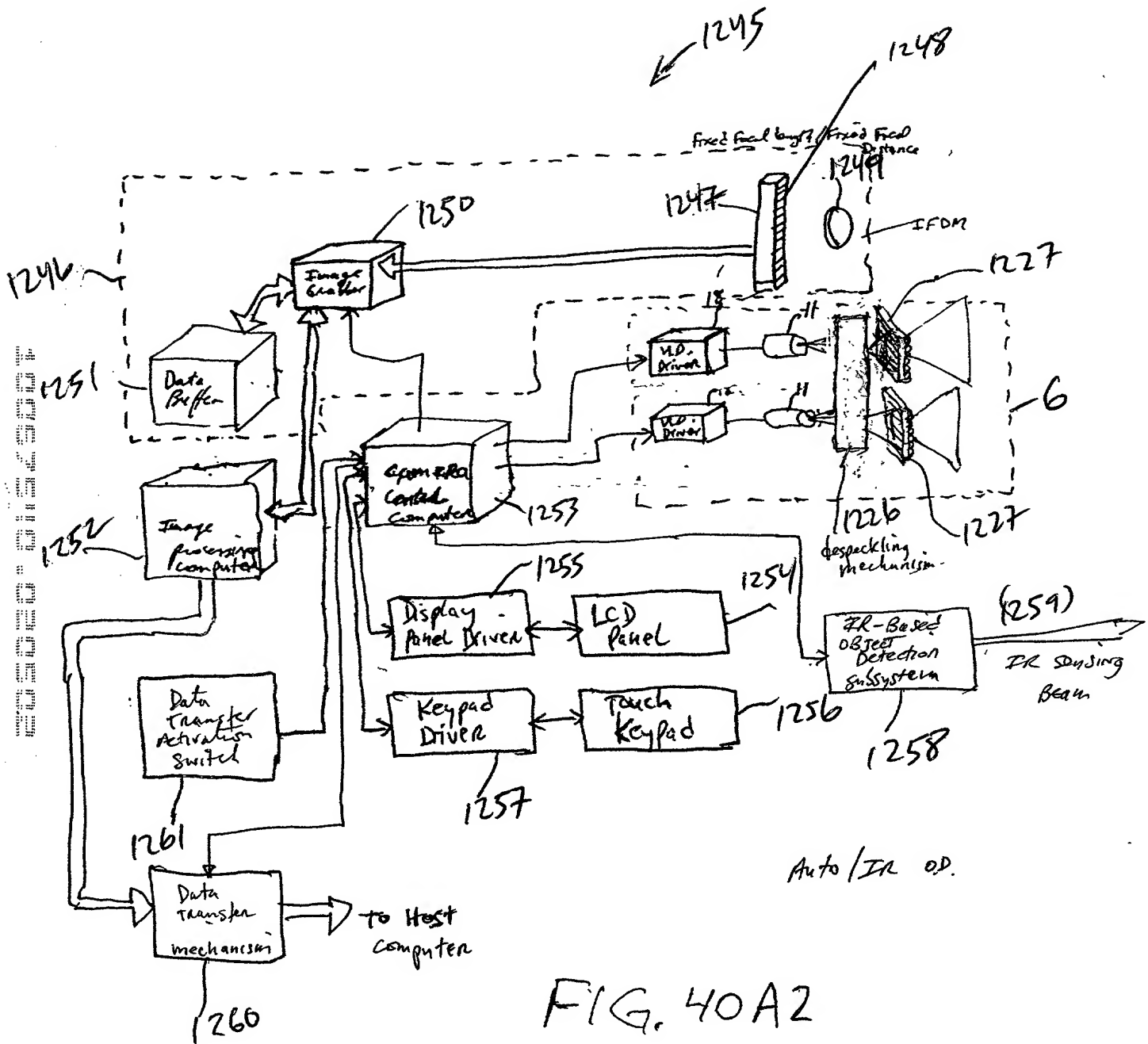


FIG. 40A2

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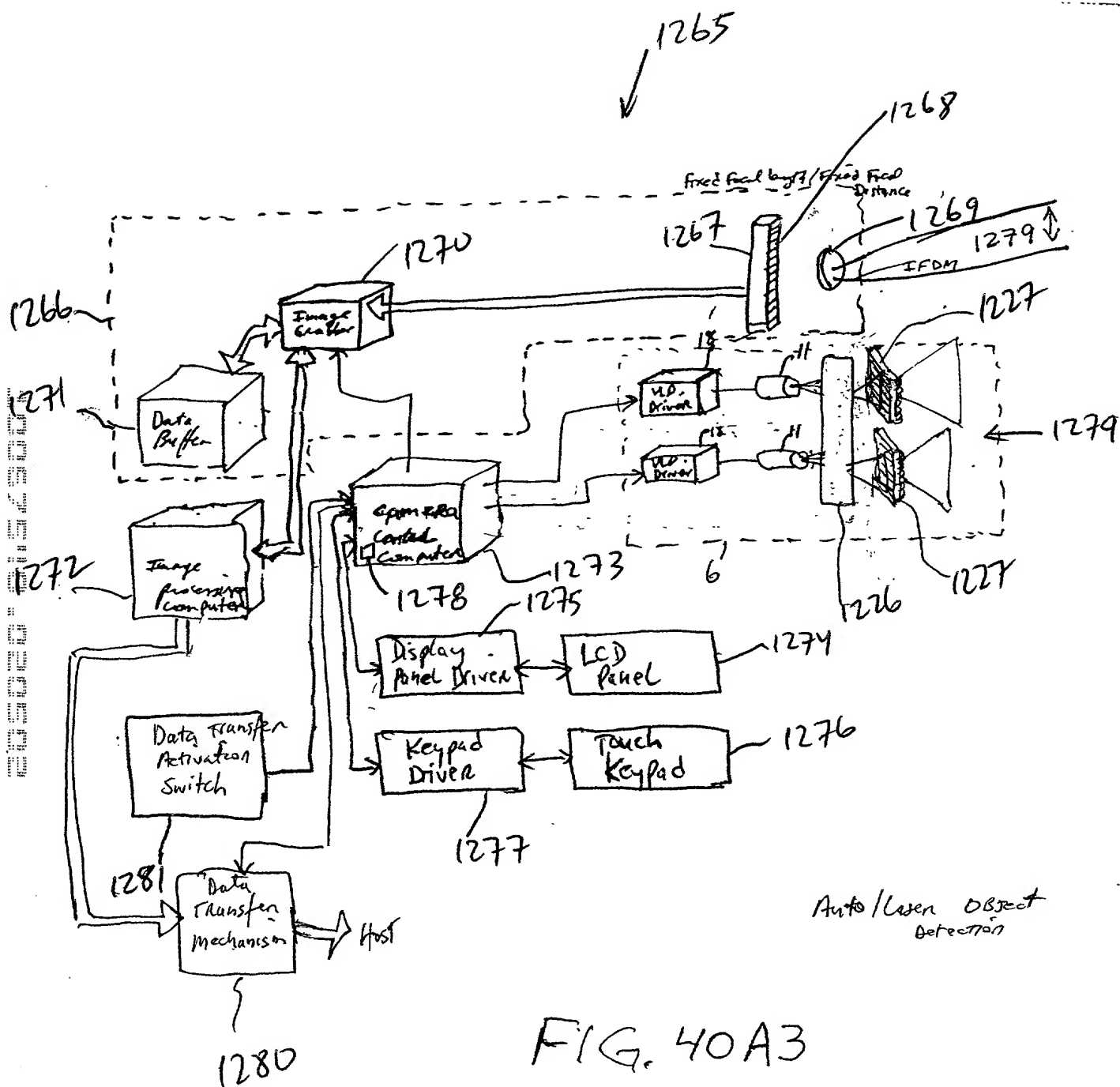
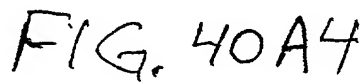
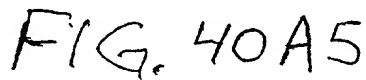


FIG. 40A3



1305



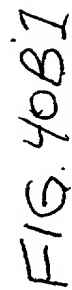


FIG. 40B1

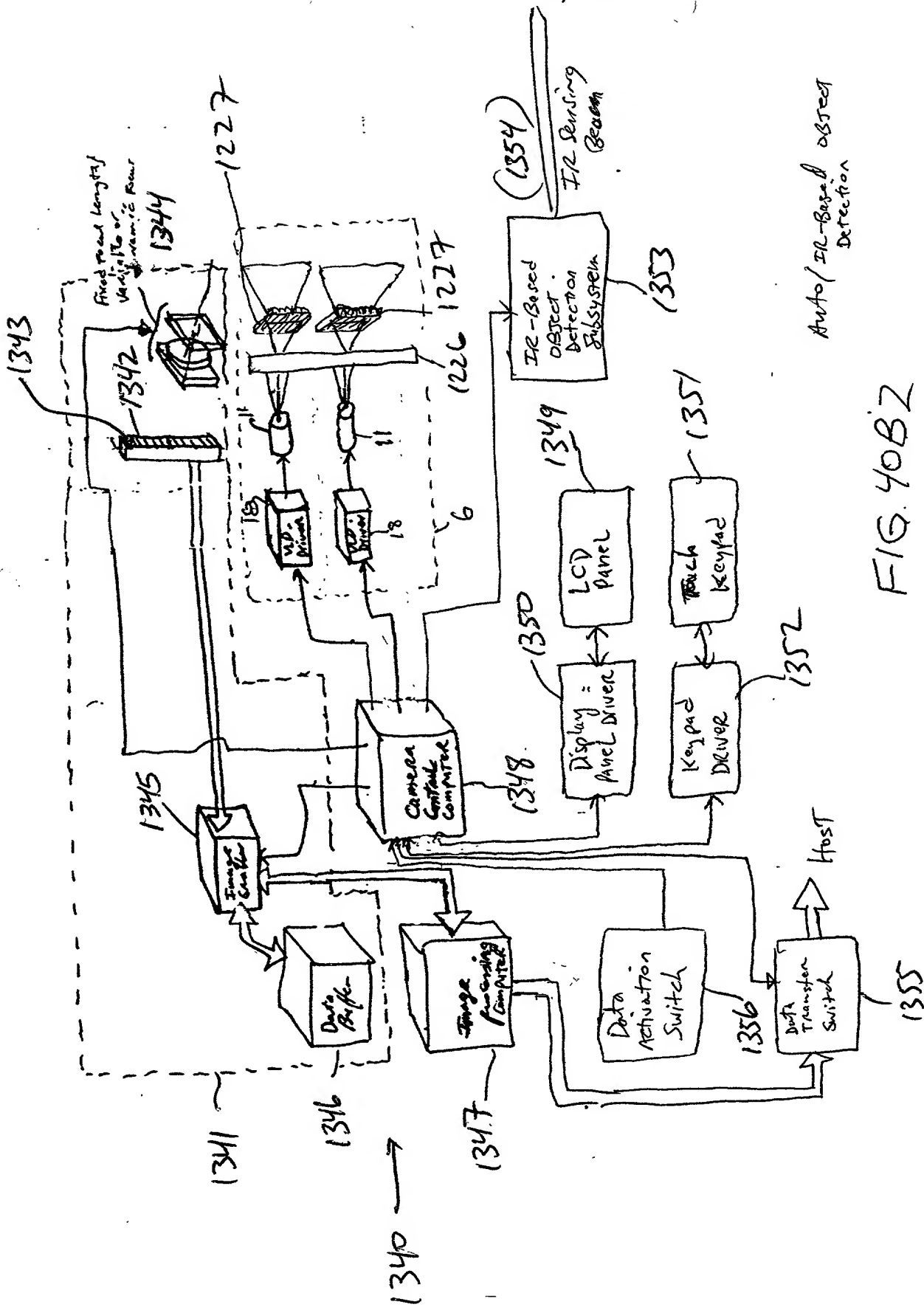
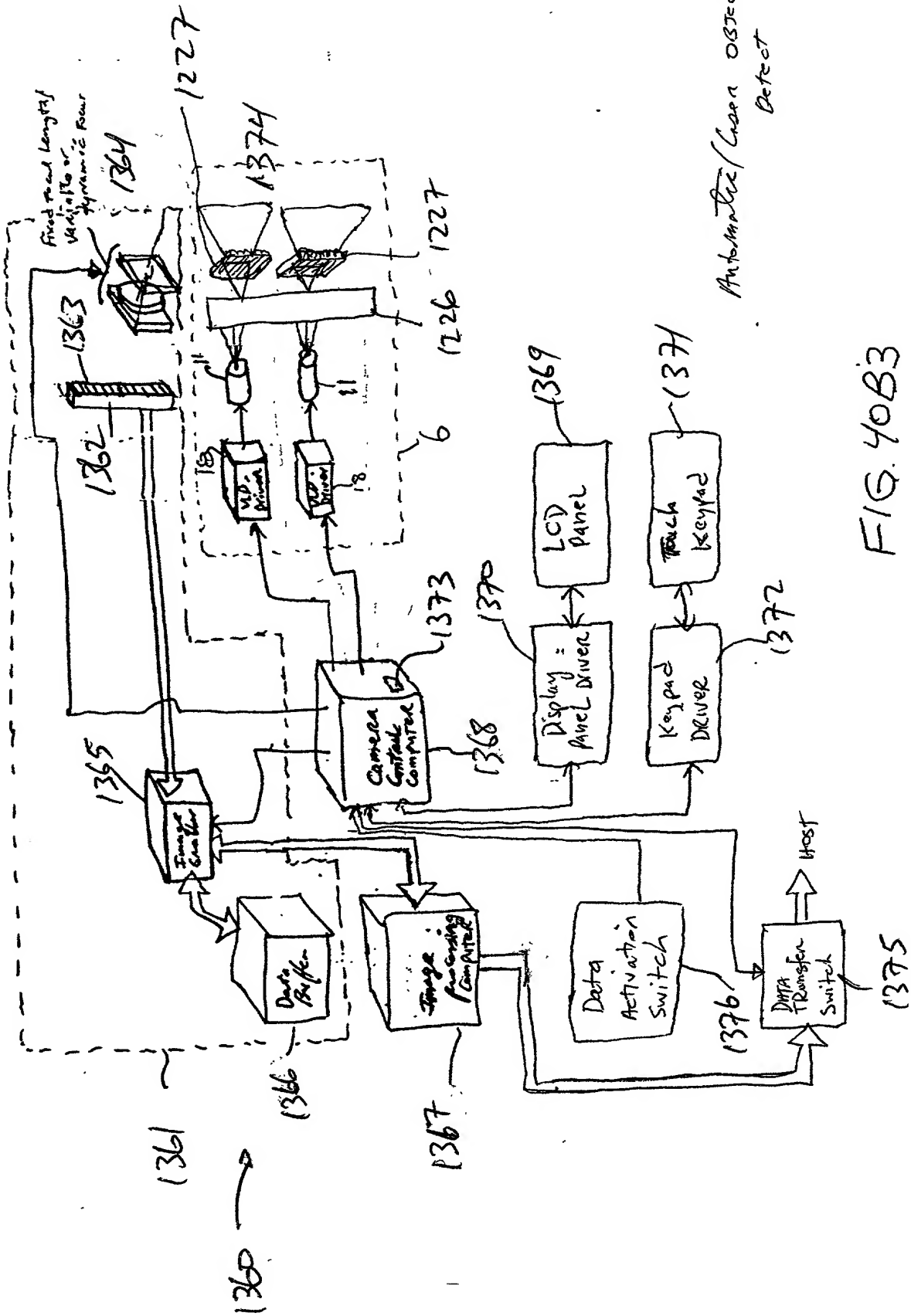
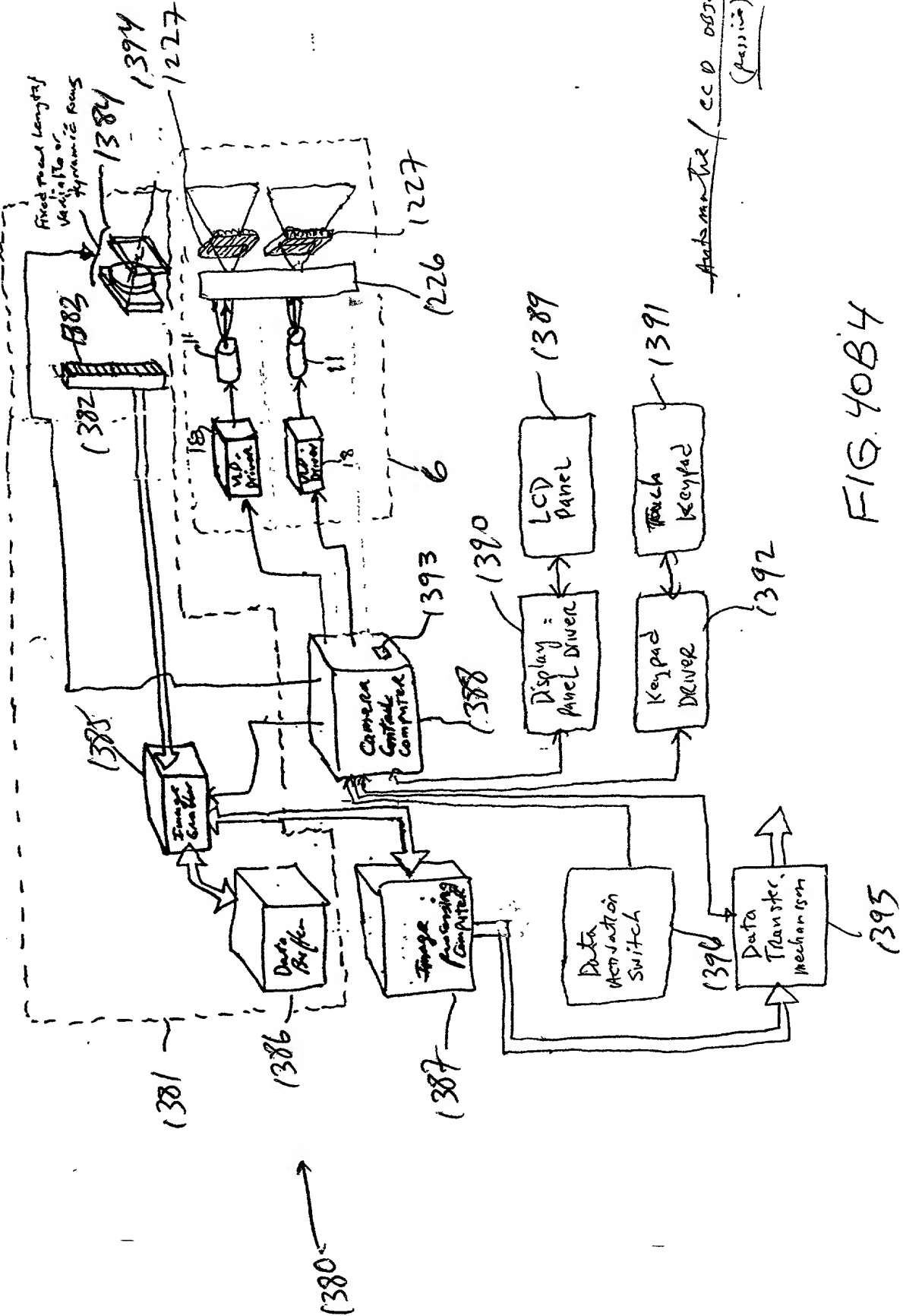


FIG. 40B2

Auto/IR-based object
Detection



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Handwritten / CCD object detect.
(passive)

FIG. 40B4

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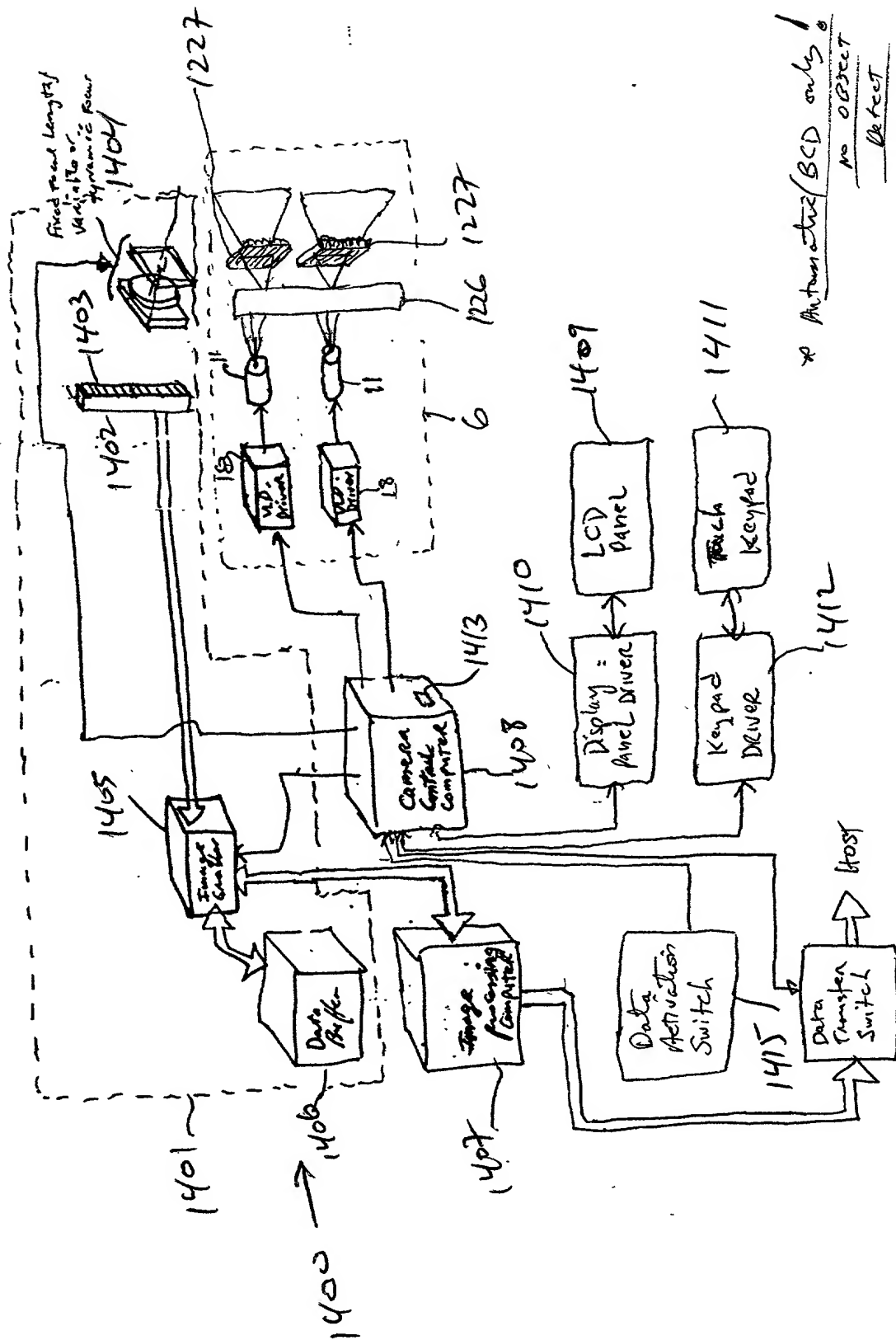


FIG. 40B5

1414

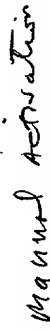


FIG. 40C1

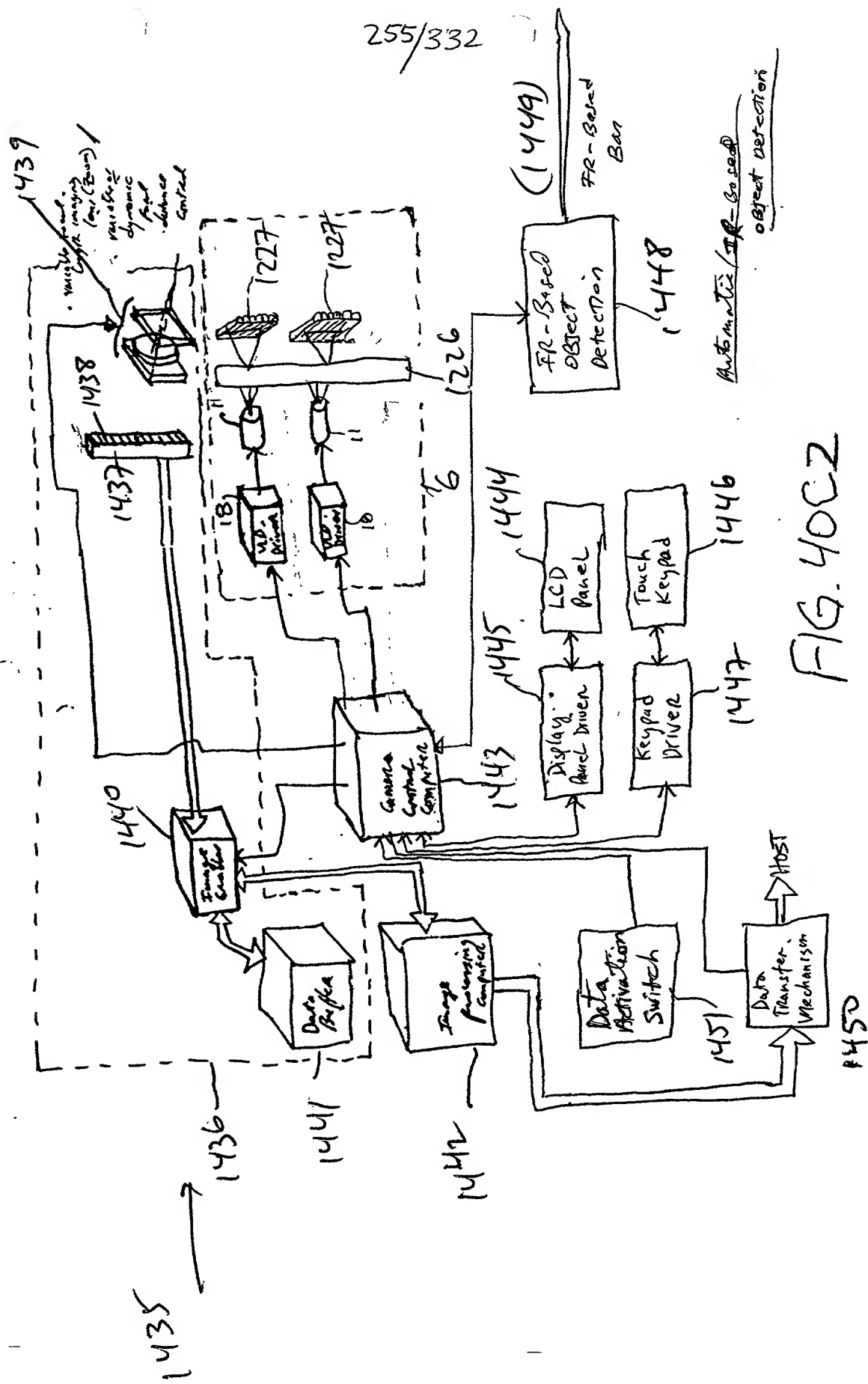
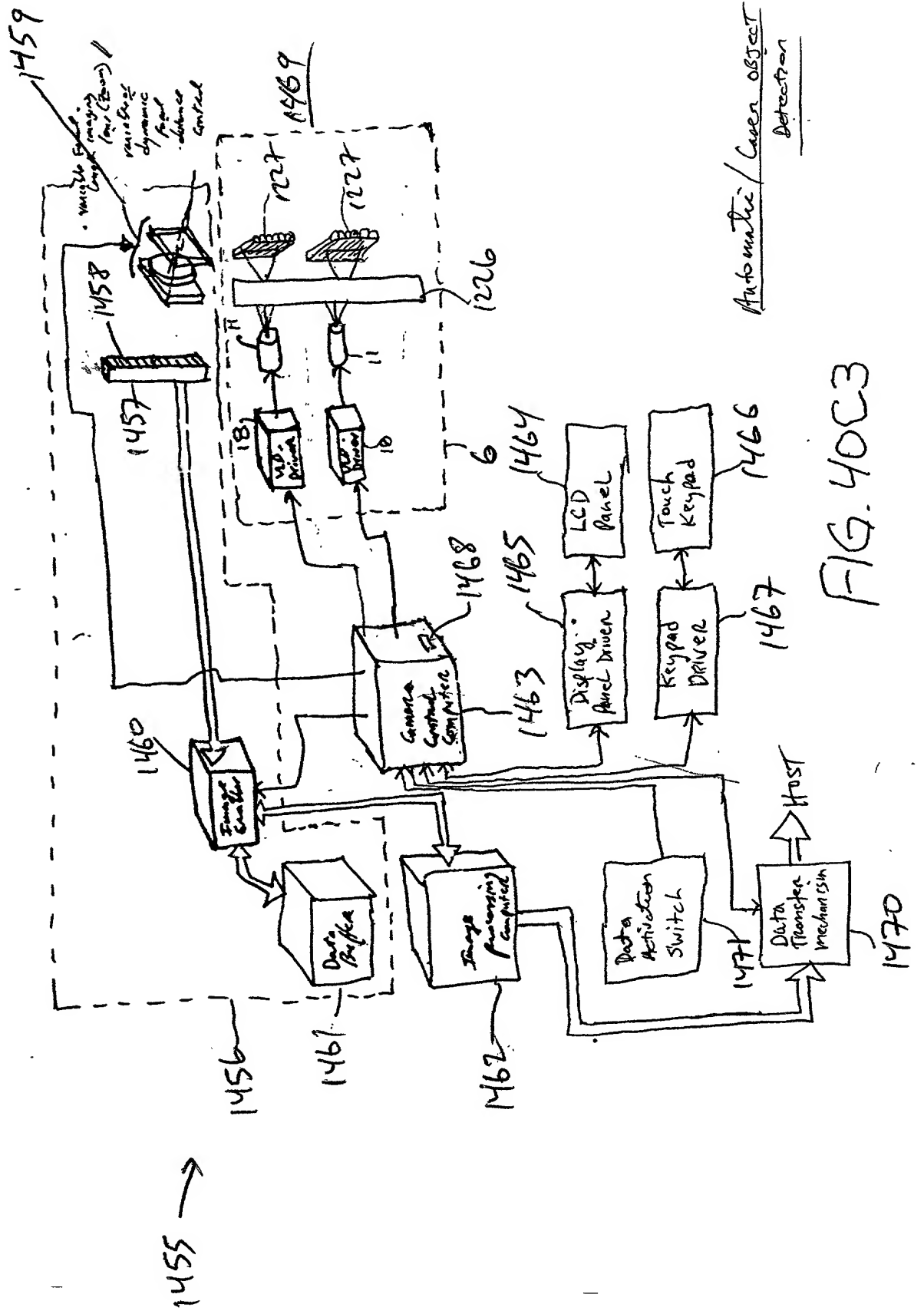
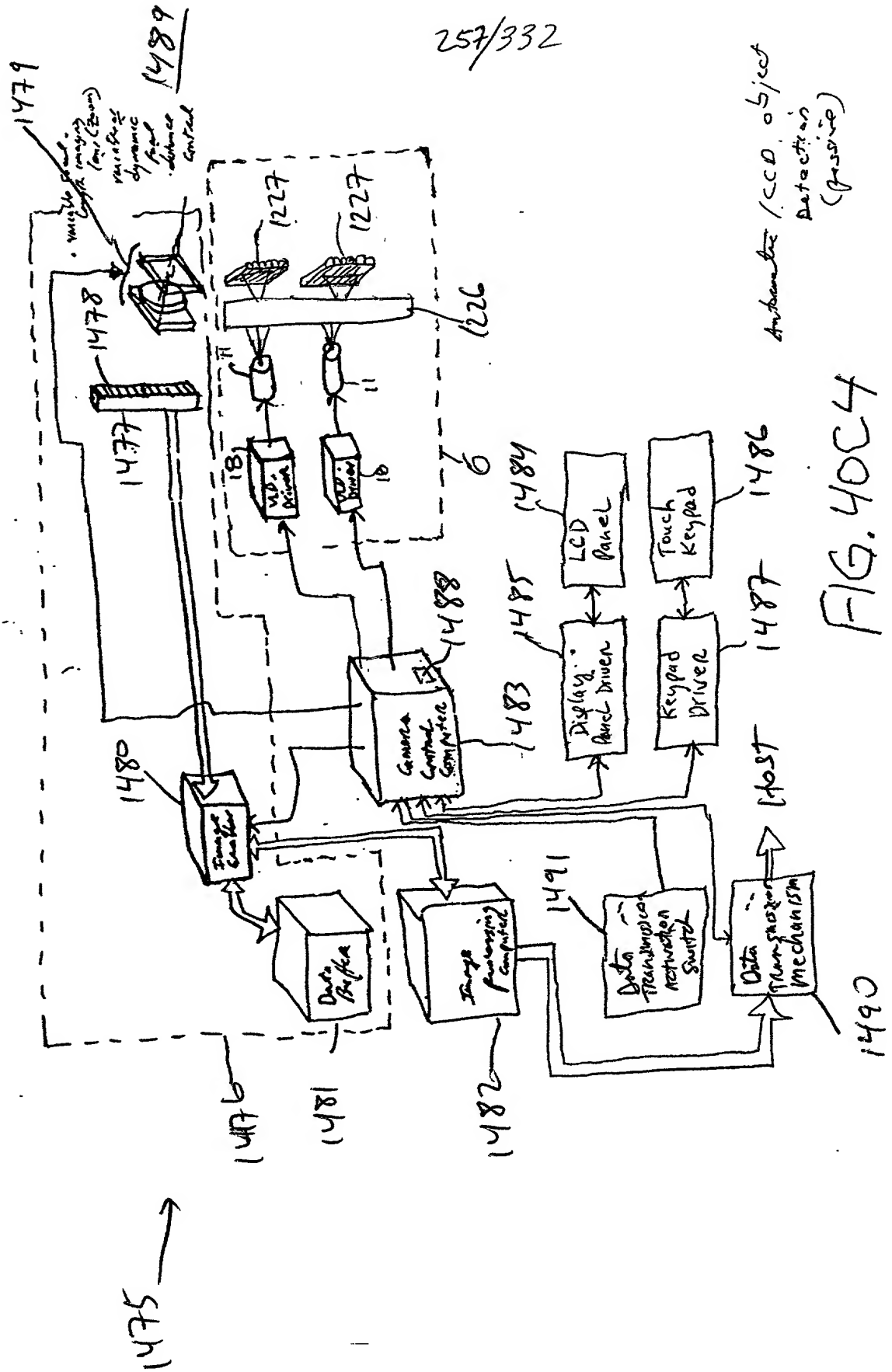


FIG. 40C2



Automatic/Camera Object Detection

FIG. 40C3



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1-D
display
...

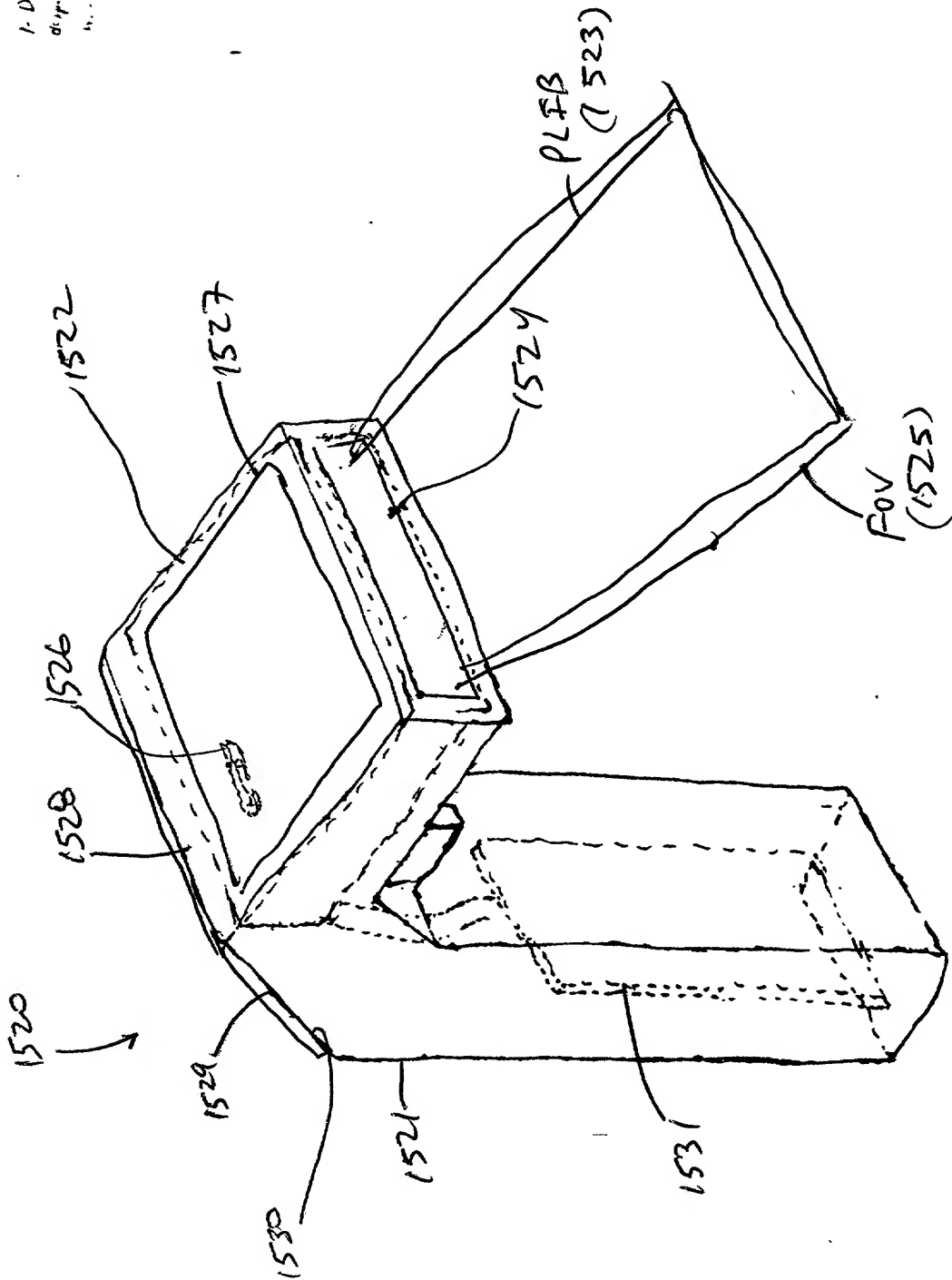


FIG. 41A

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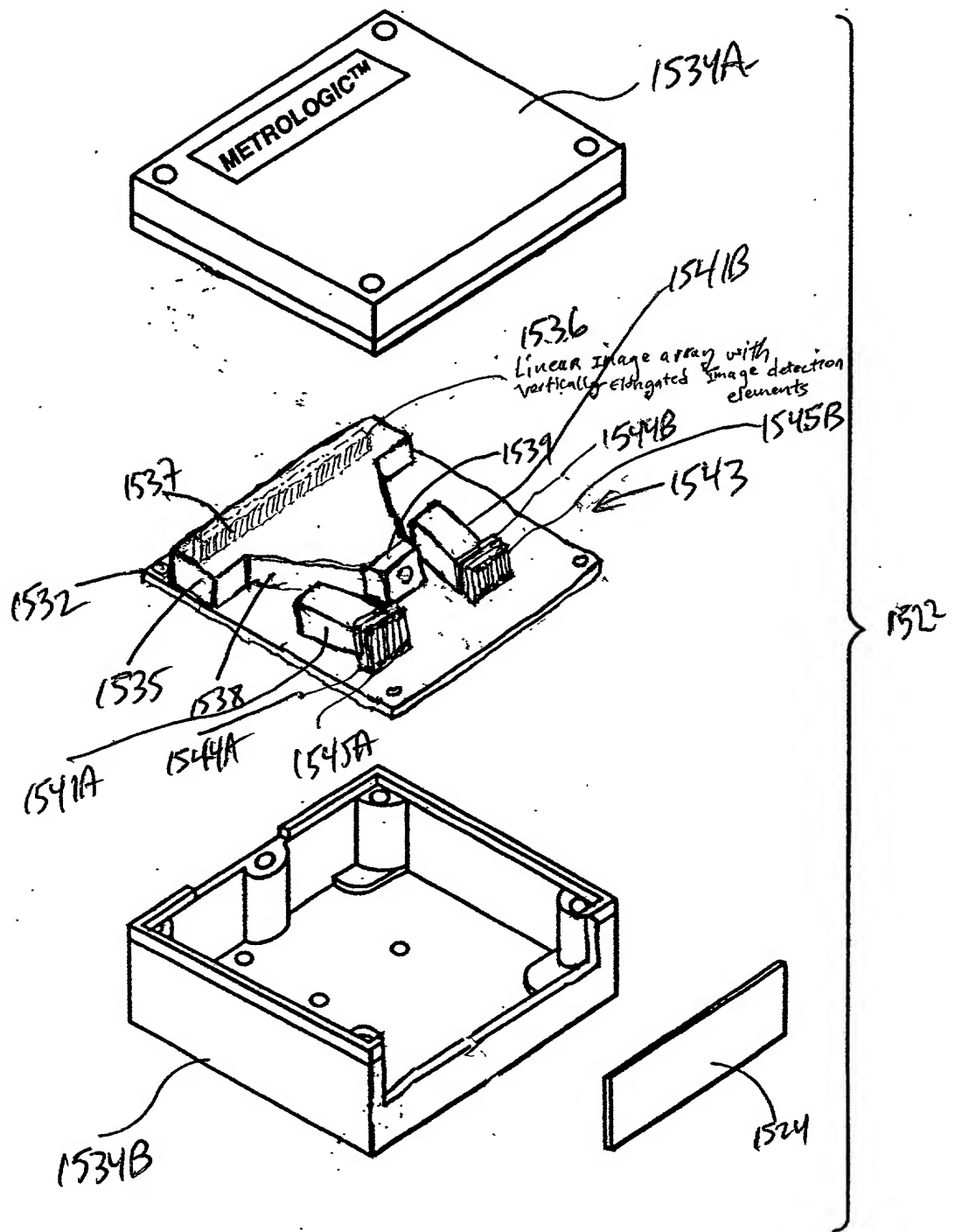


FIG. 41B

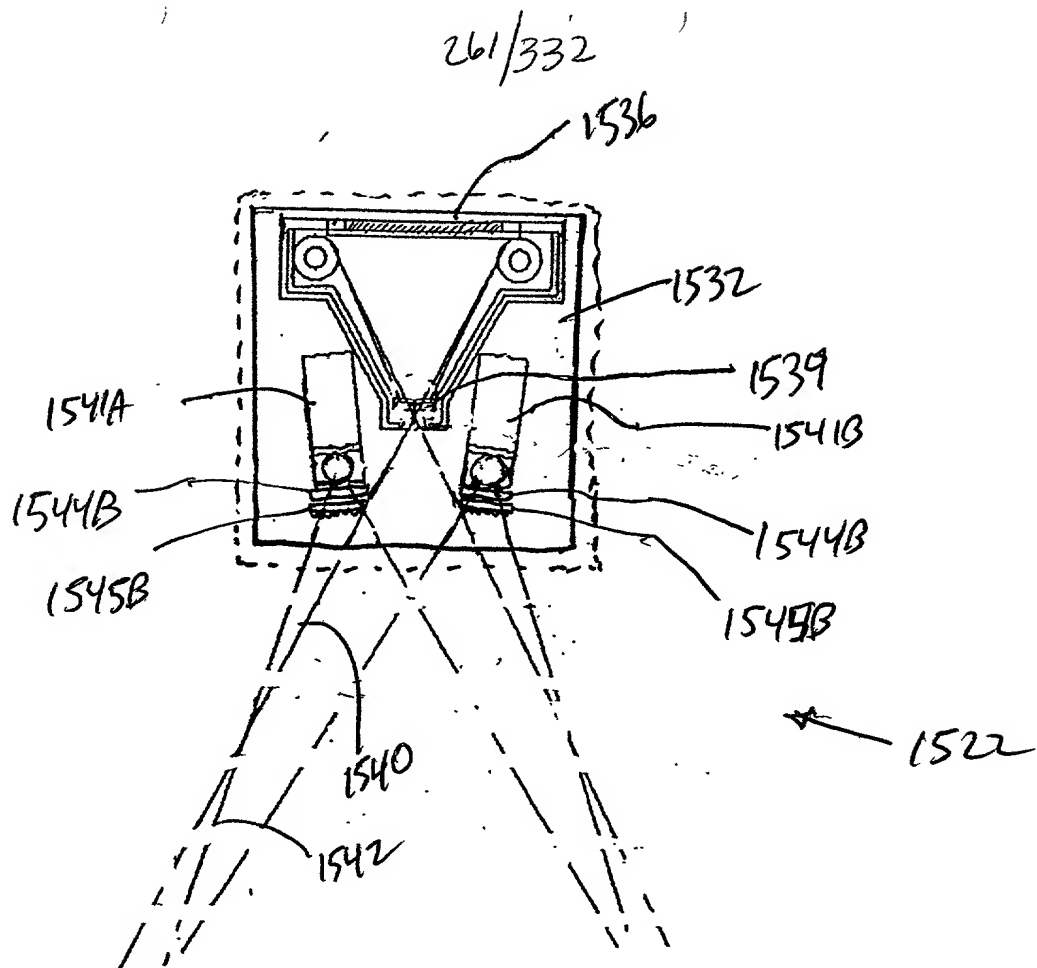


FIG. 41C

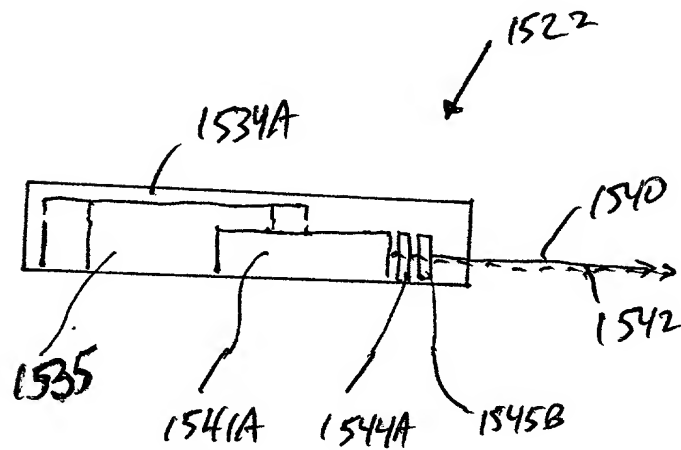


FIG. 41D

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1-D
display
...

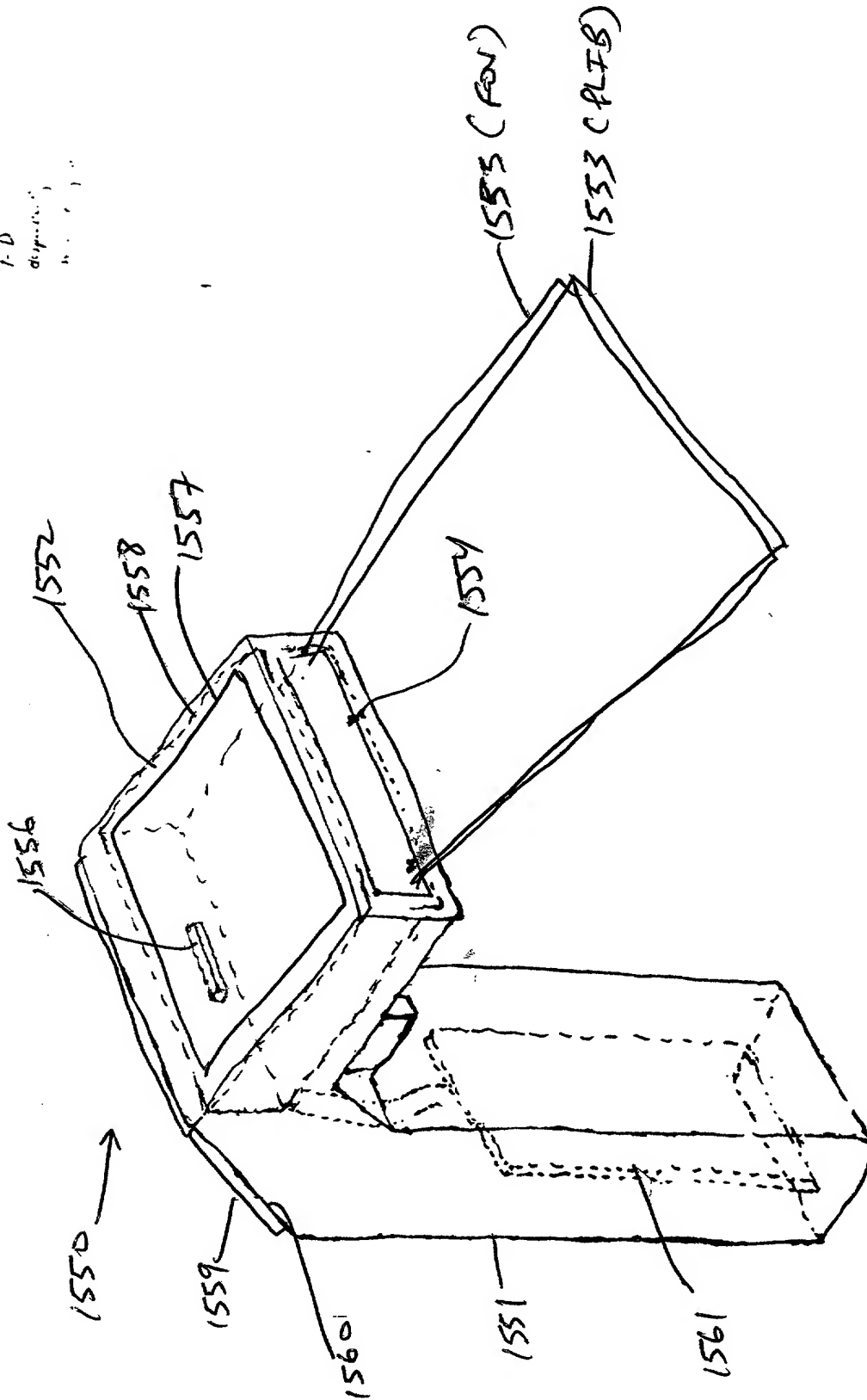


FIG. 42A

Host Computer/Network

Data Comm.
Link

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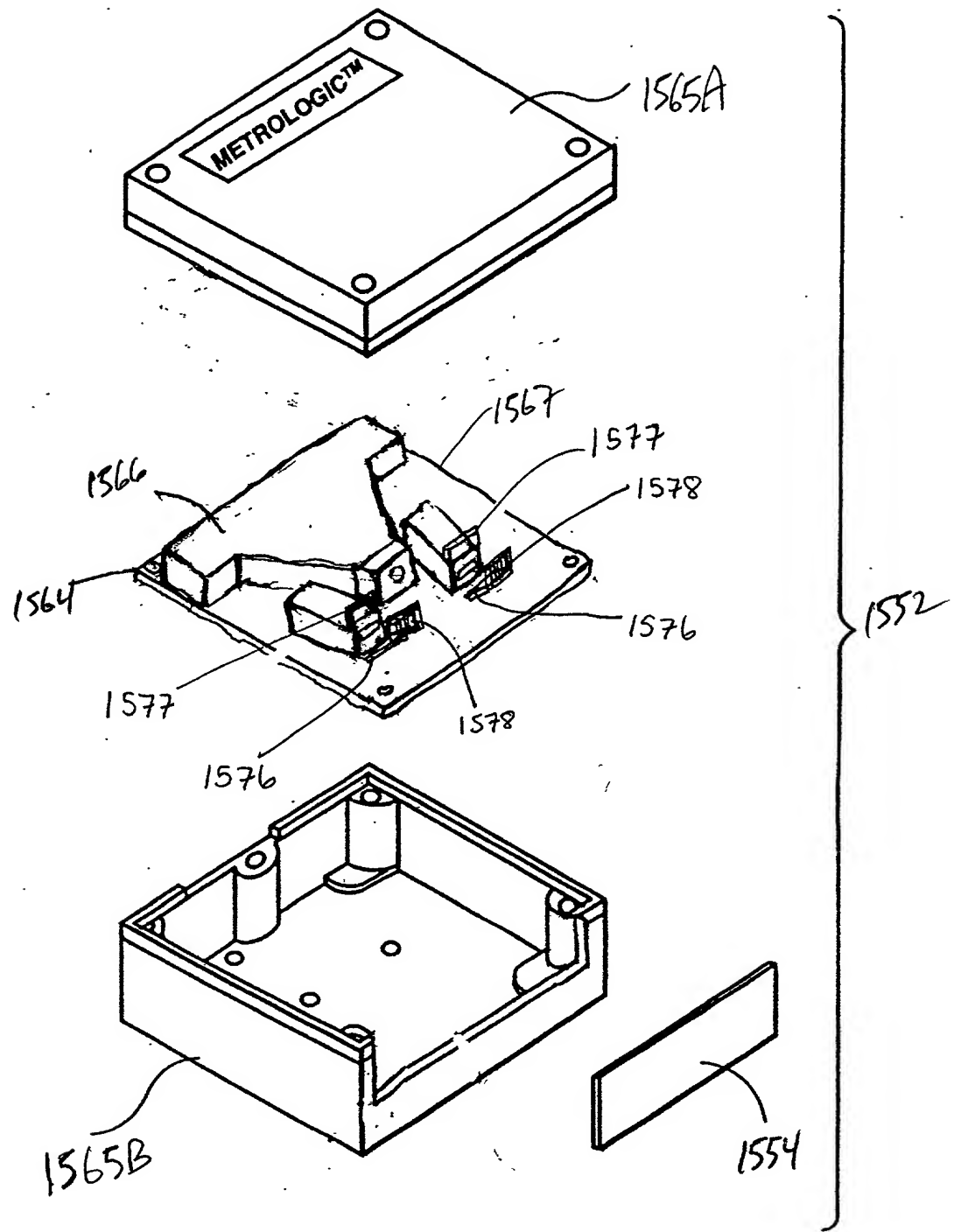


FIG. 42B

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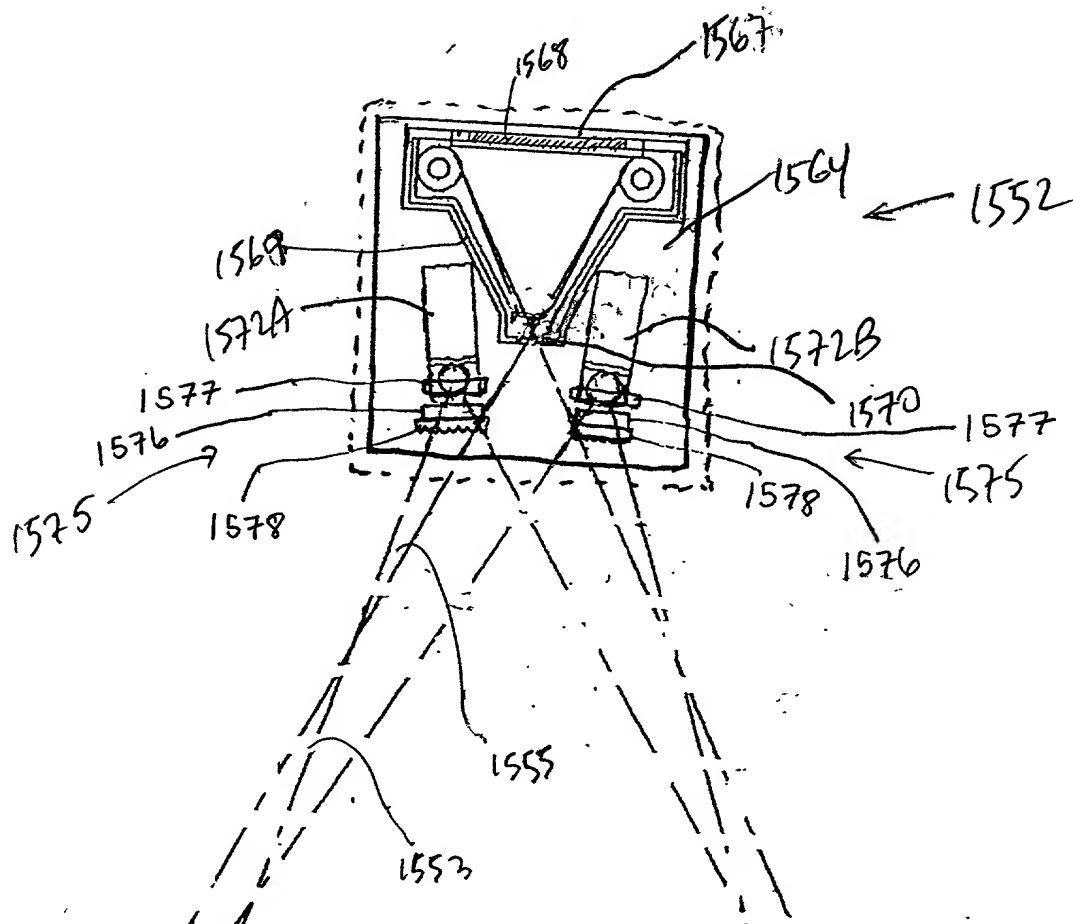


FIG. 42C

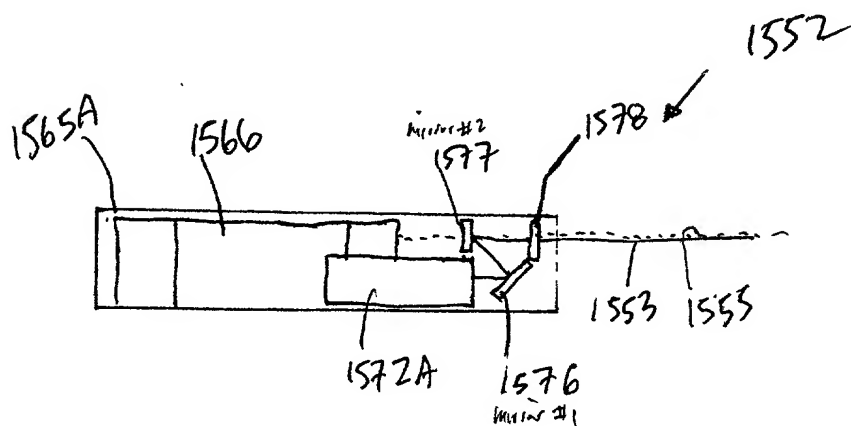


FIG. 42D

1-D
displacement
in x, y, z

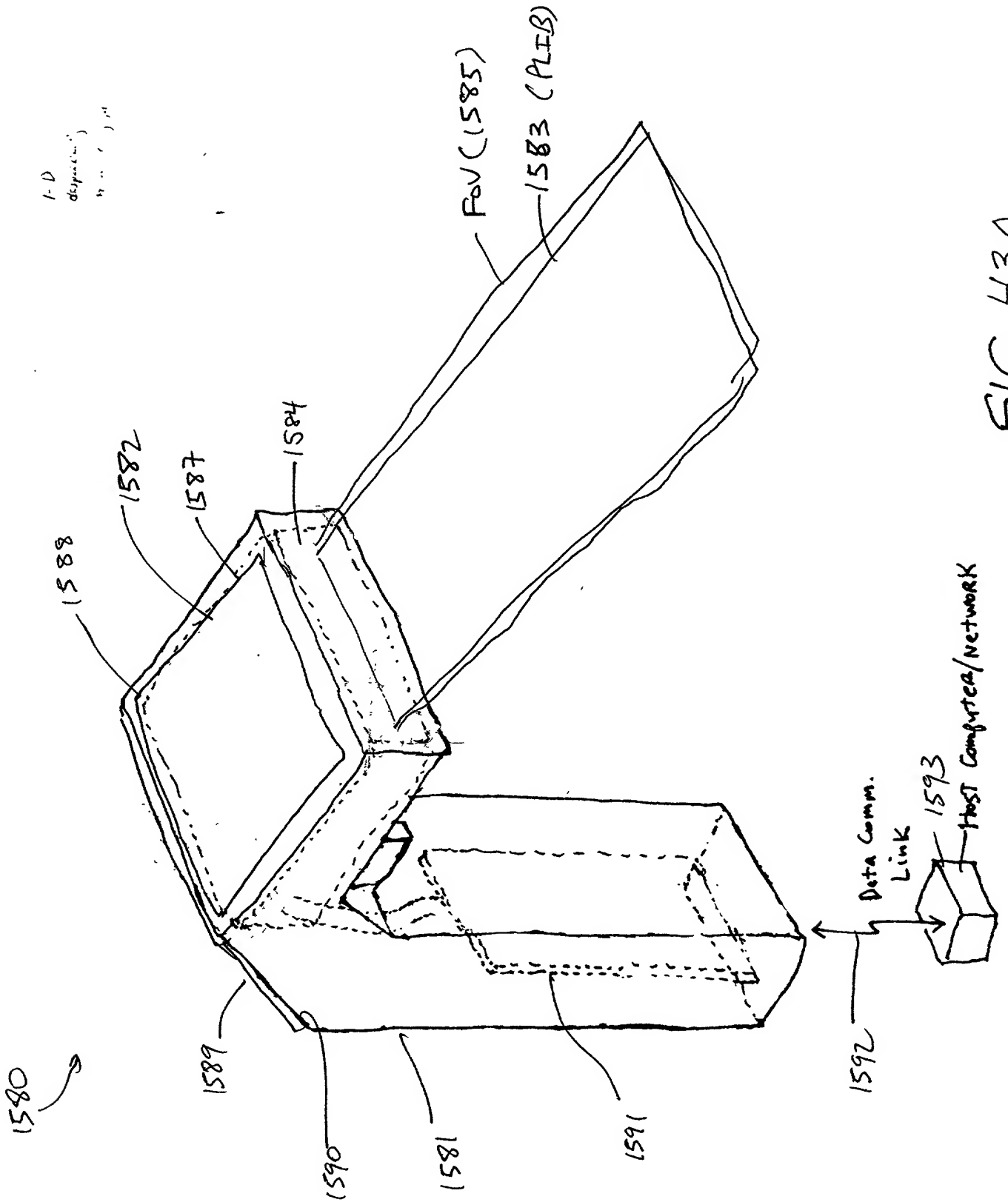


FIG. 43A

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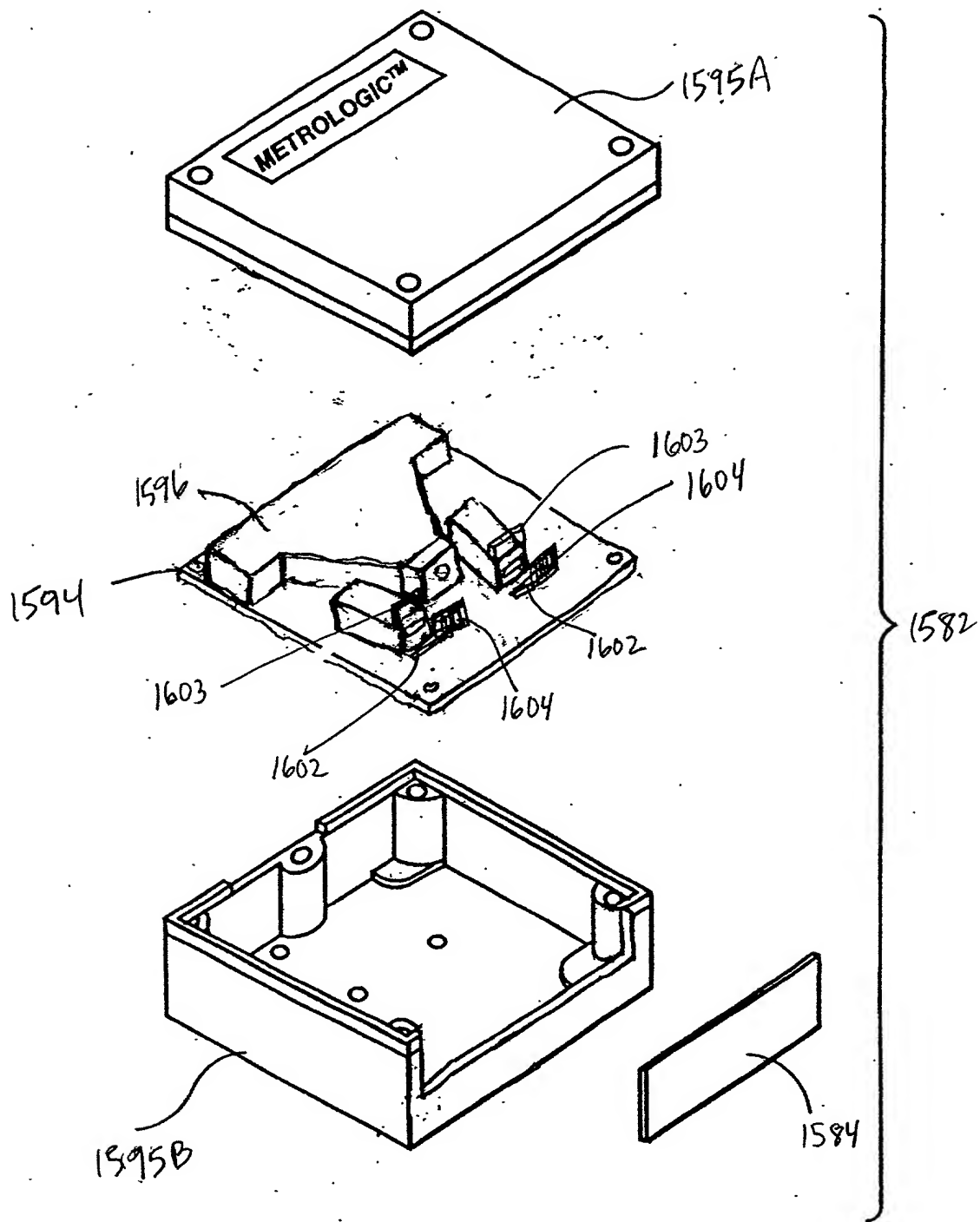


FIG. 43B

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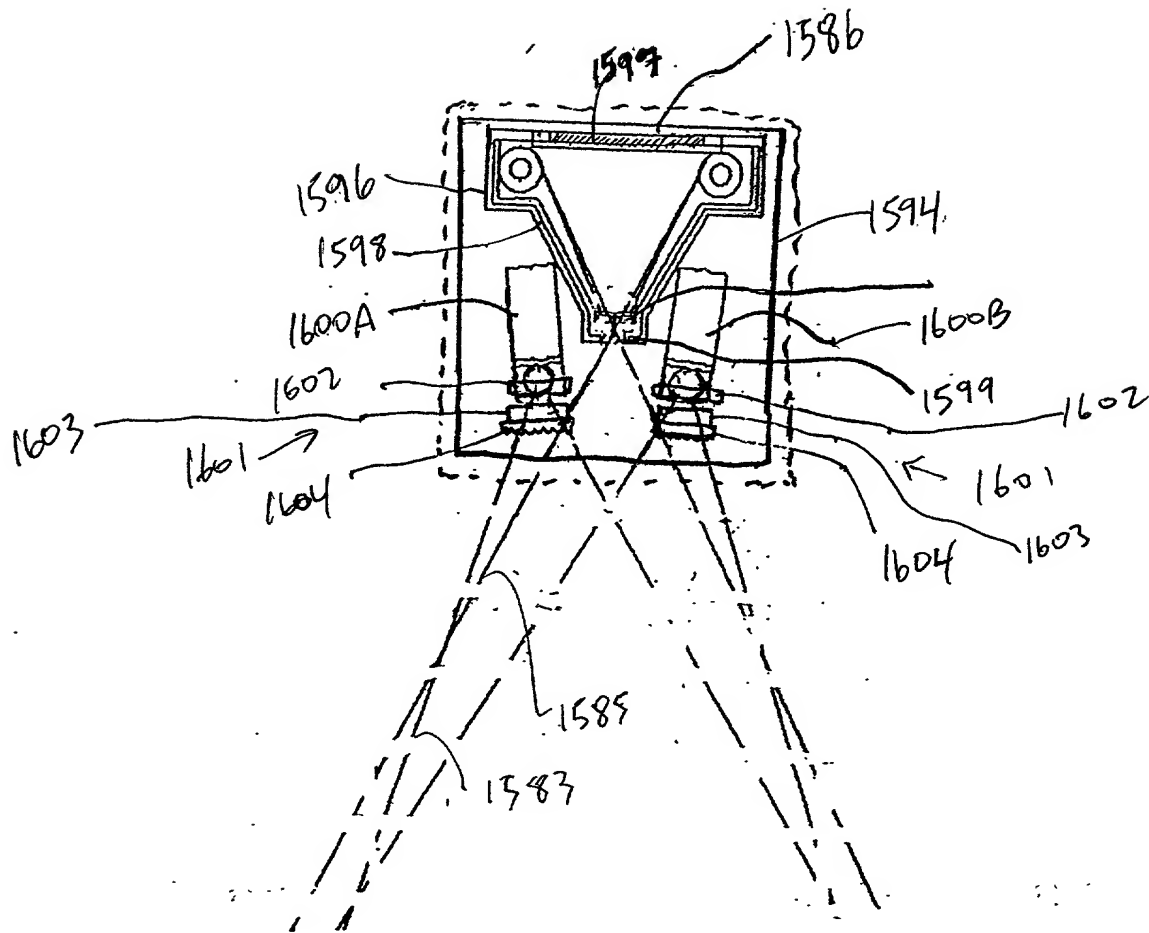


FIG. 43C

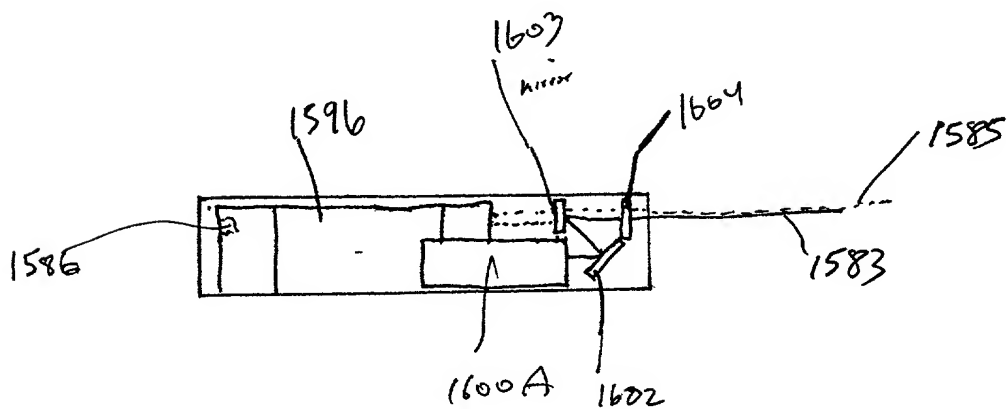


FIG. 43D

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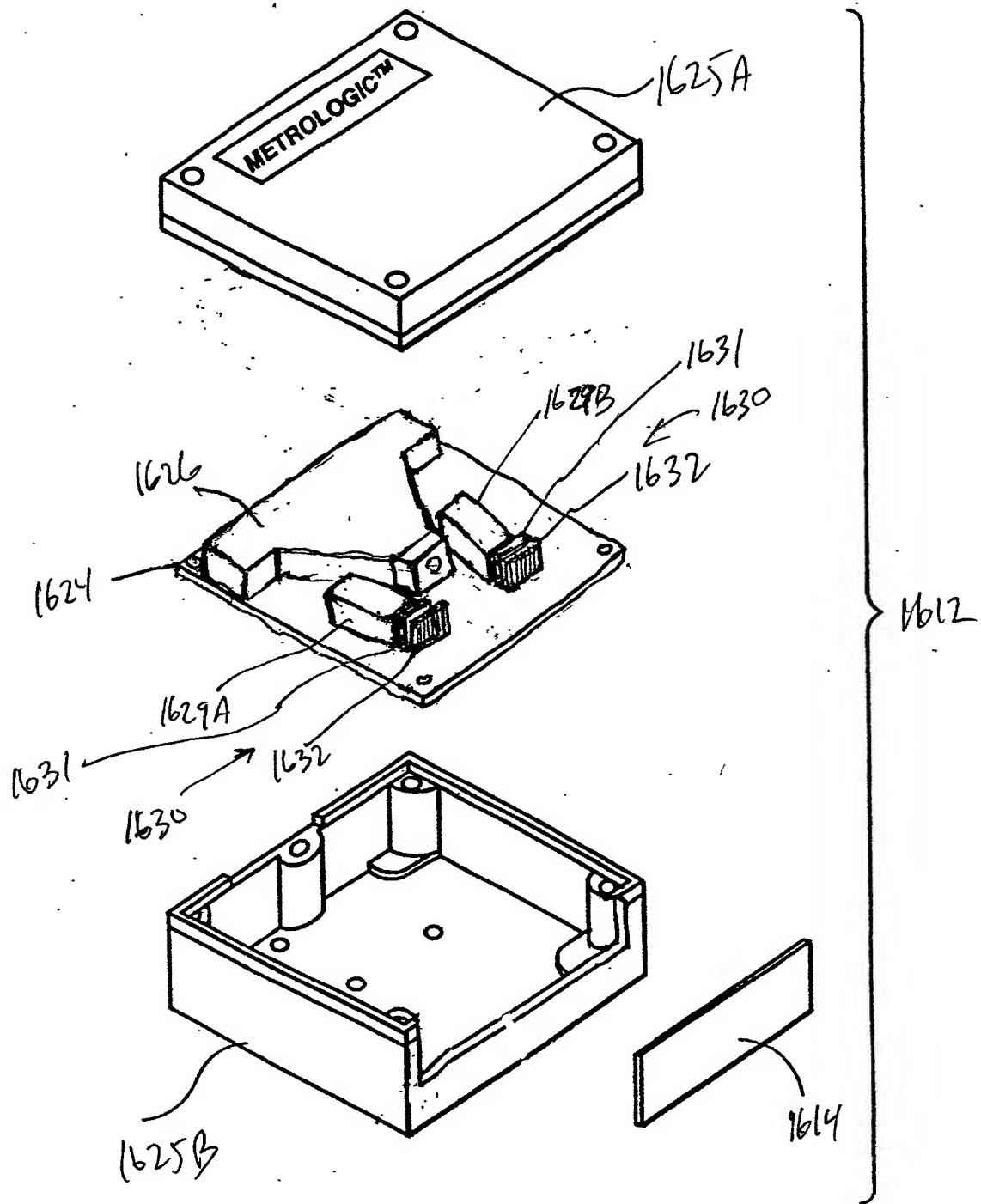


FIG. 44B

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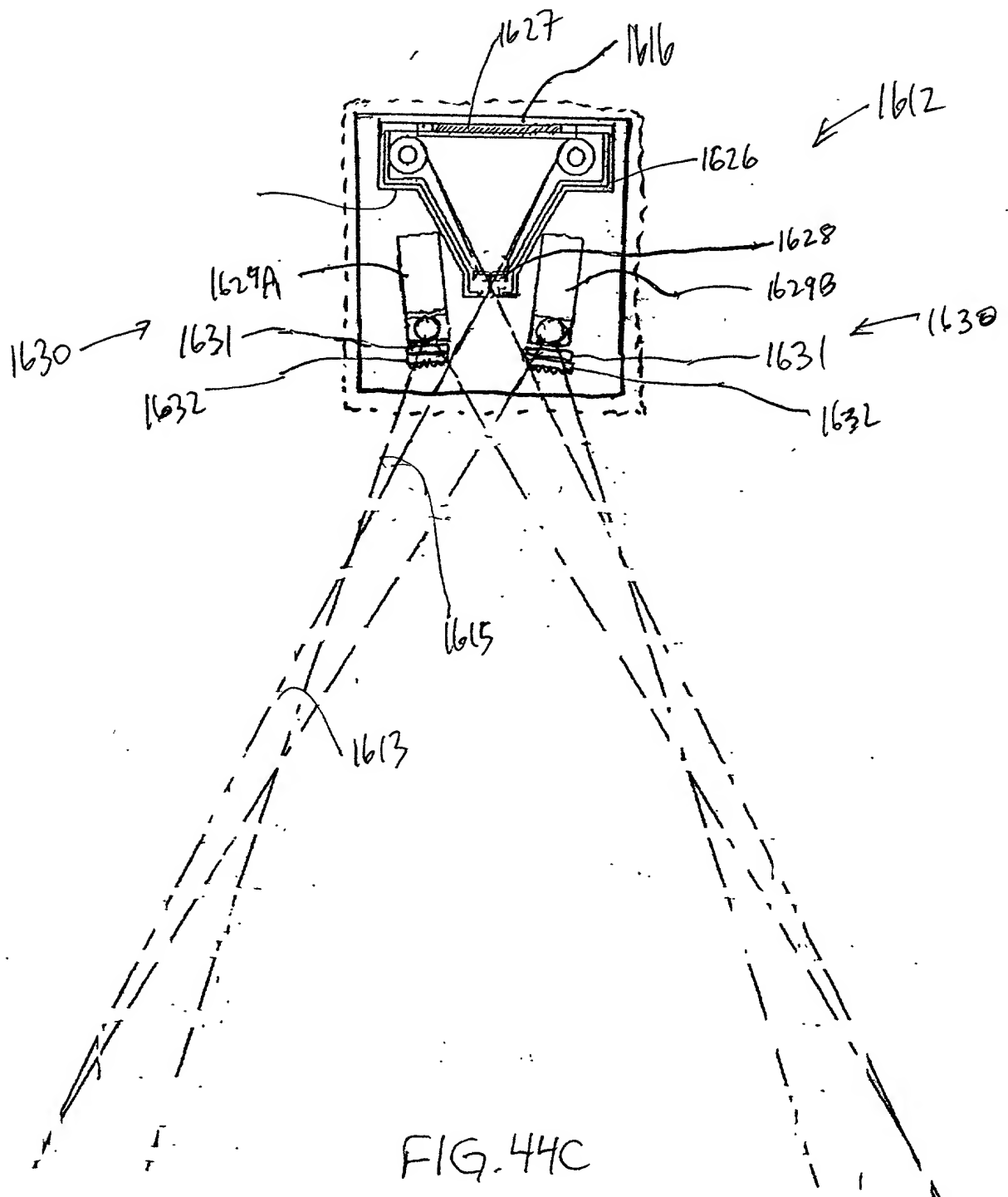


FIG. 44C

1-D
desperately
... ..

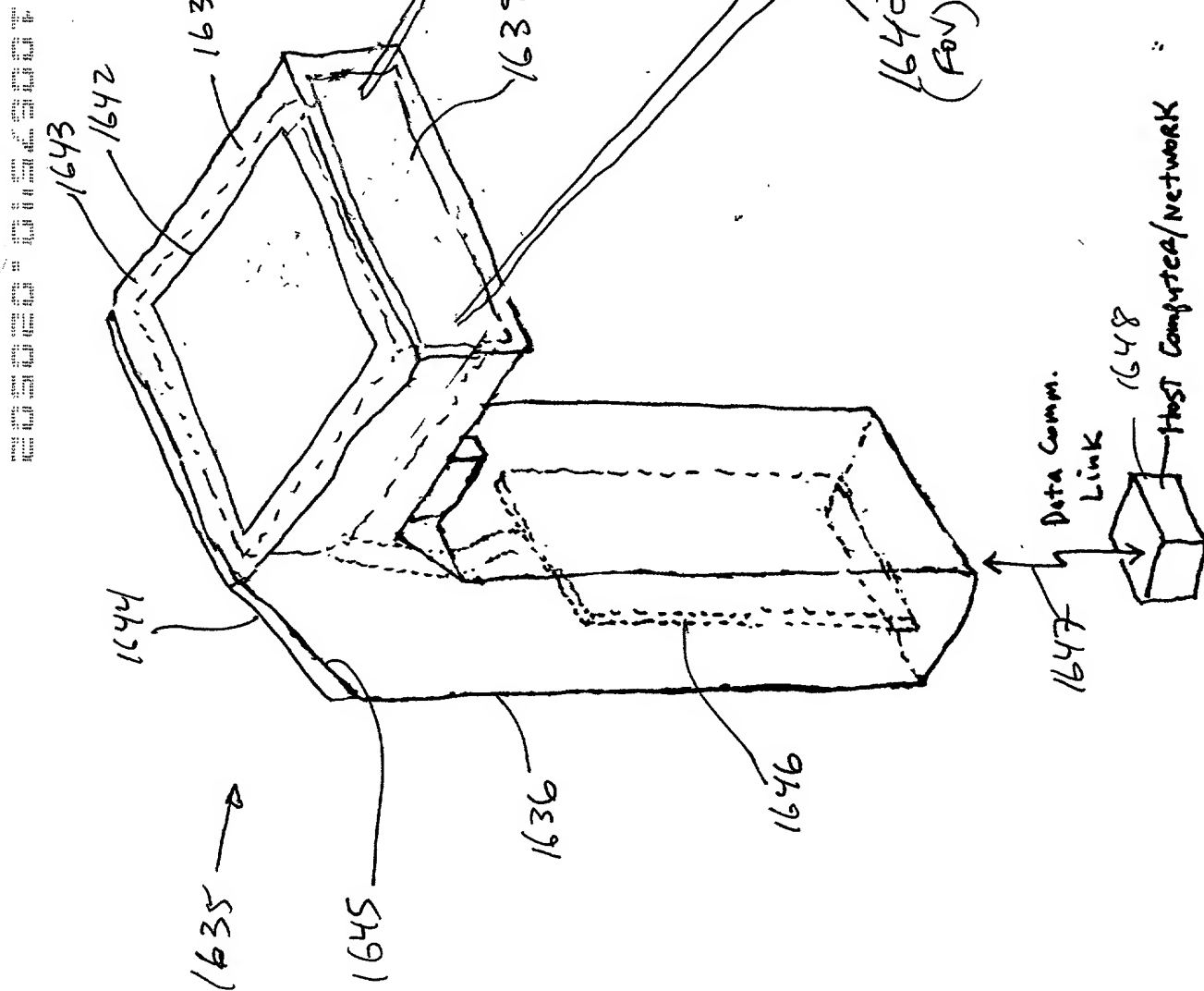


FIG. 45A

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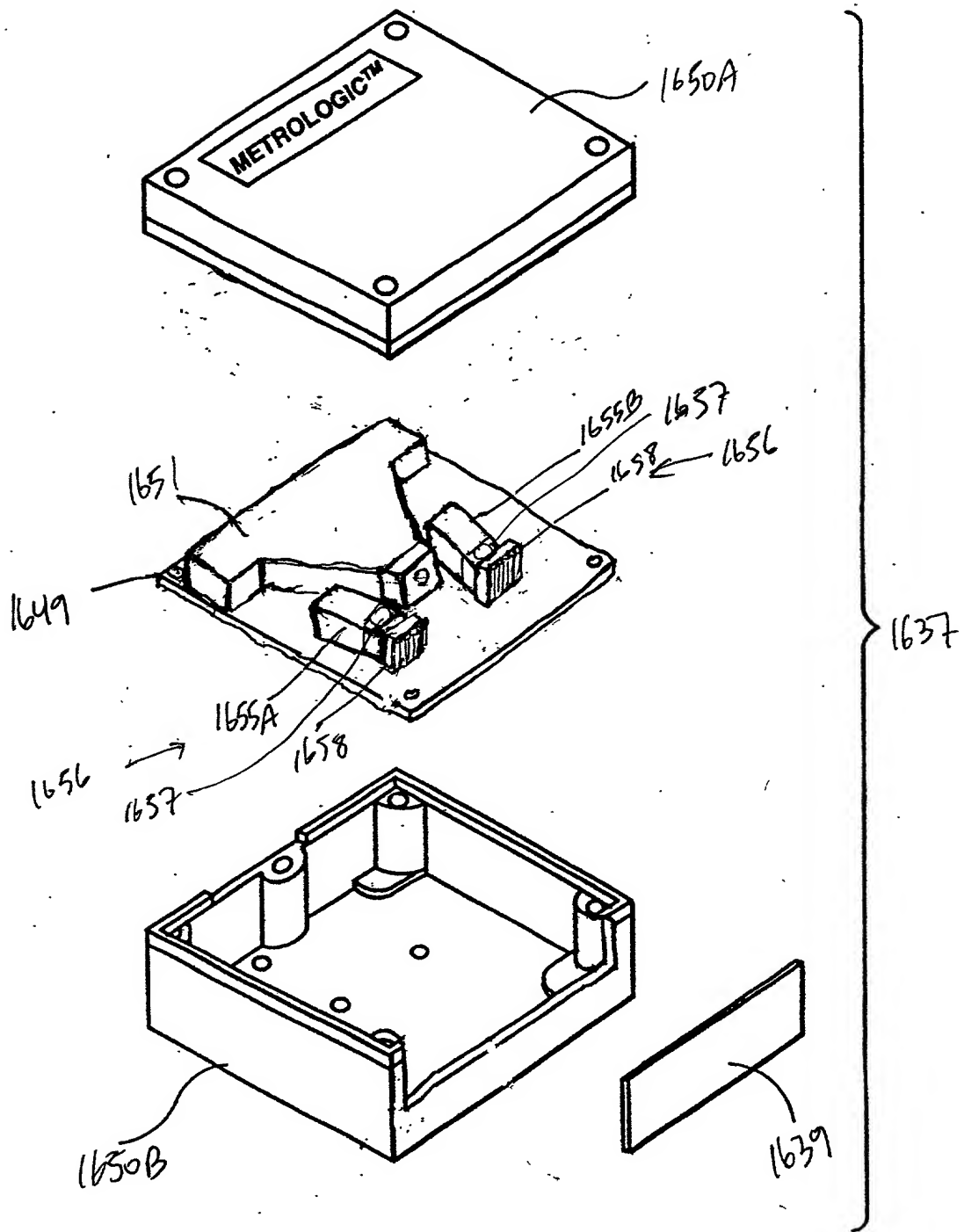


FIG. 45B

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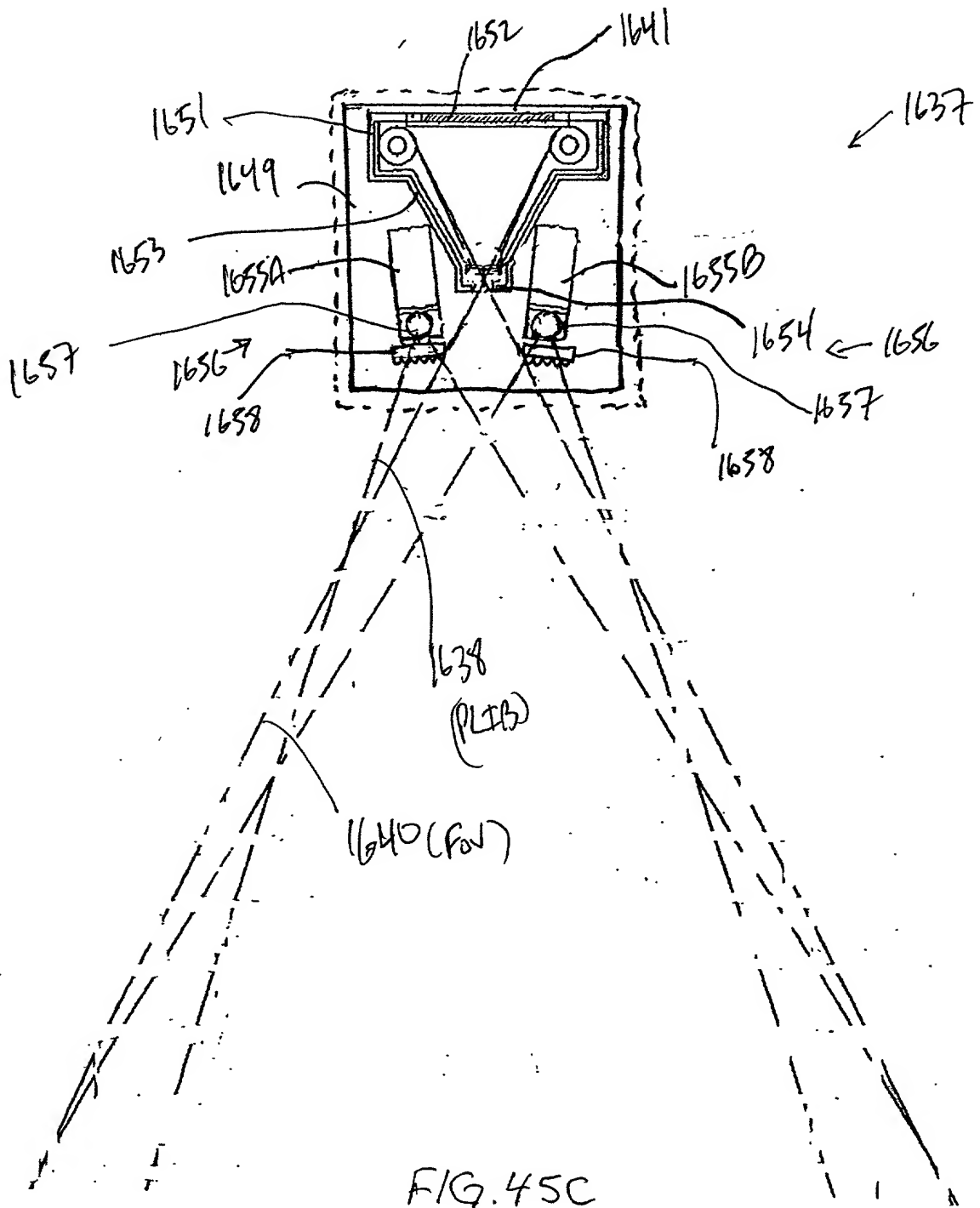


FIG. 45C

FIG. 46A

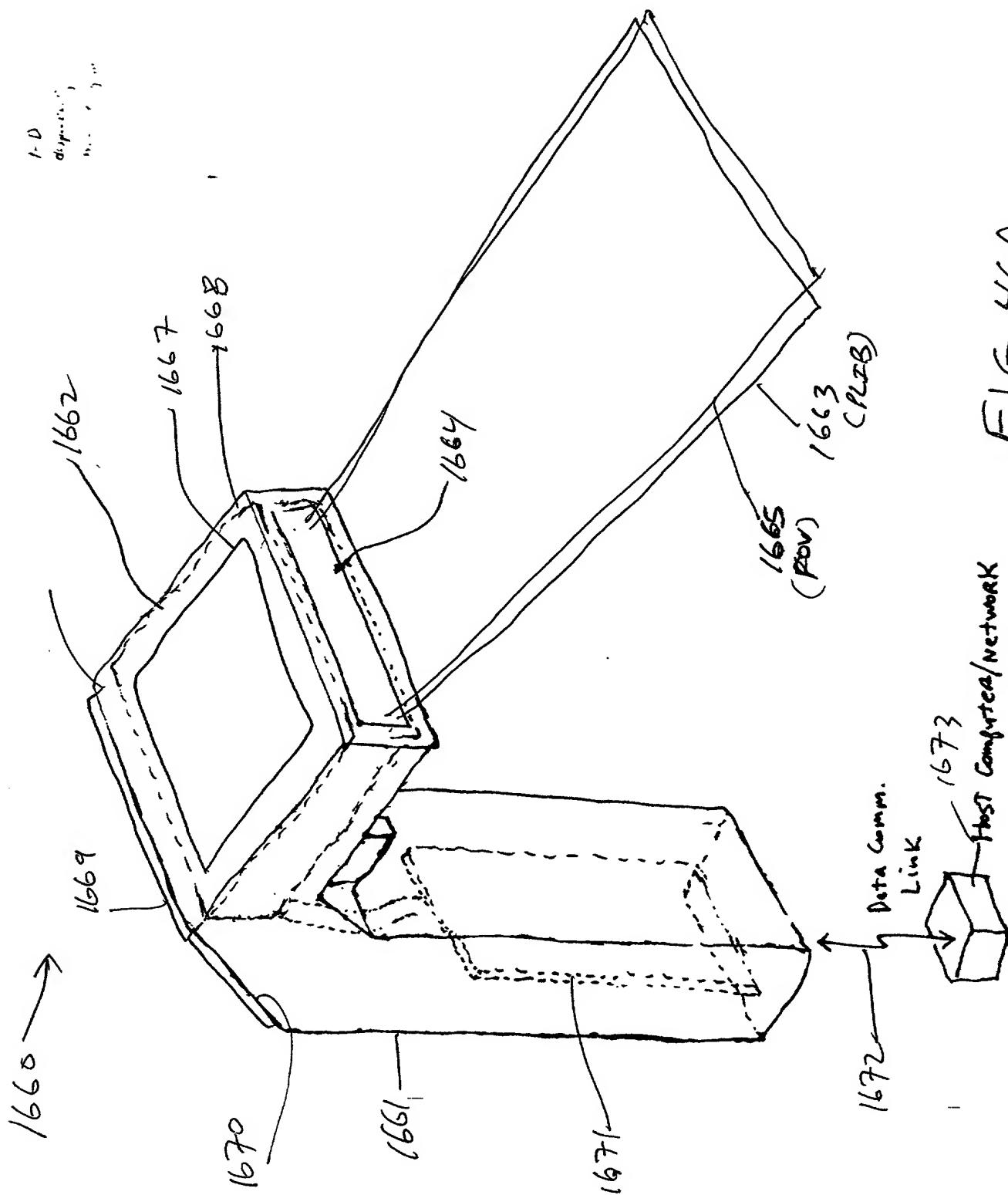


FIG. 46A

Host Computer/Network

Data Comm.
Link

1673

1672

1671

1661

1670

1669

1662

1667

1668

1664

1665 (POV)

1663 (PLTB)

1-D
display
unit

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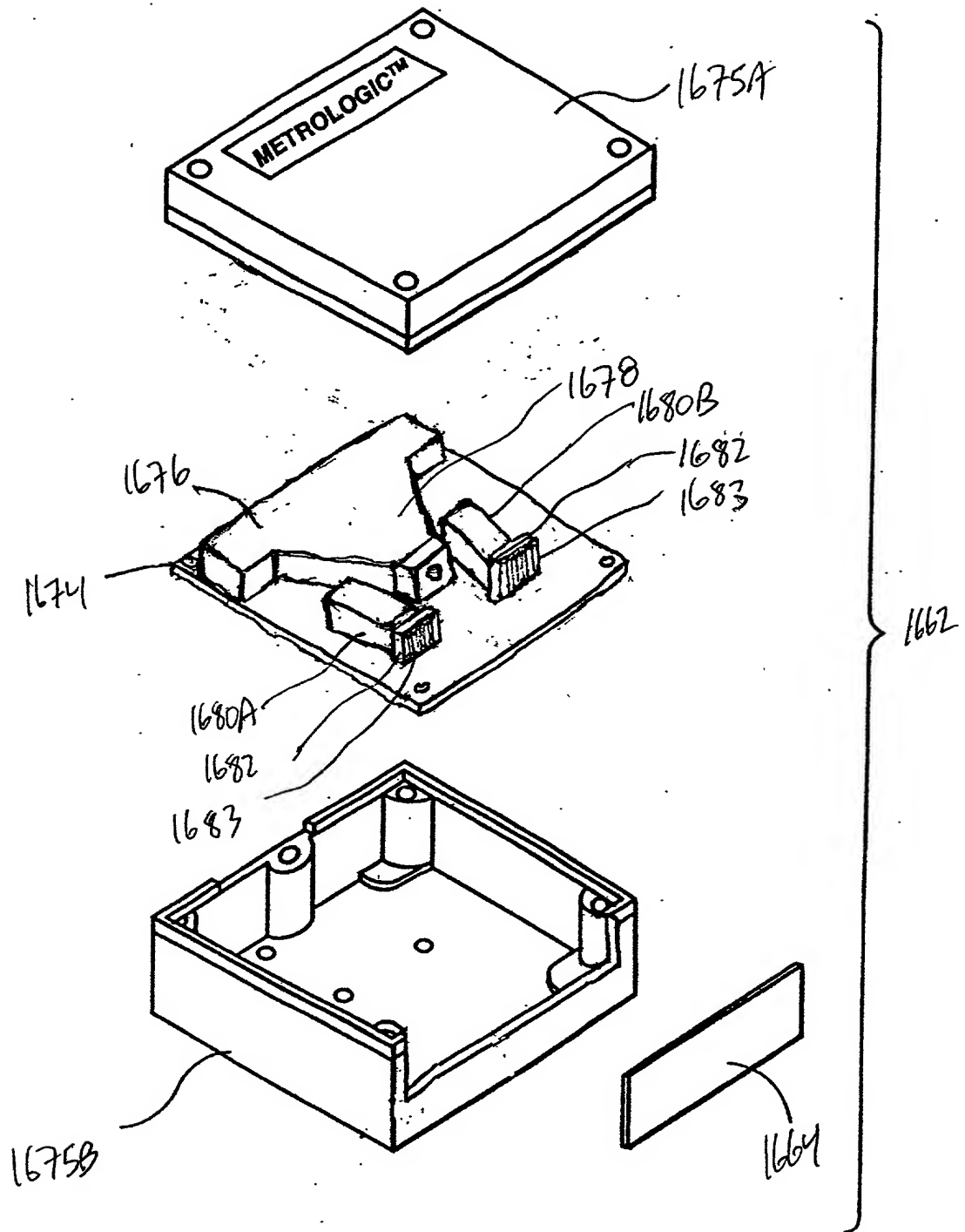


FIG. 46B

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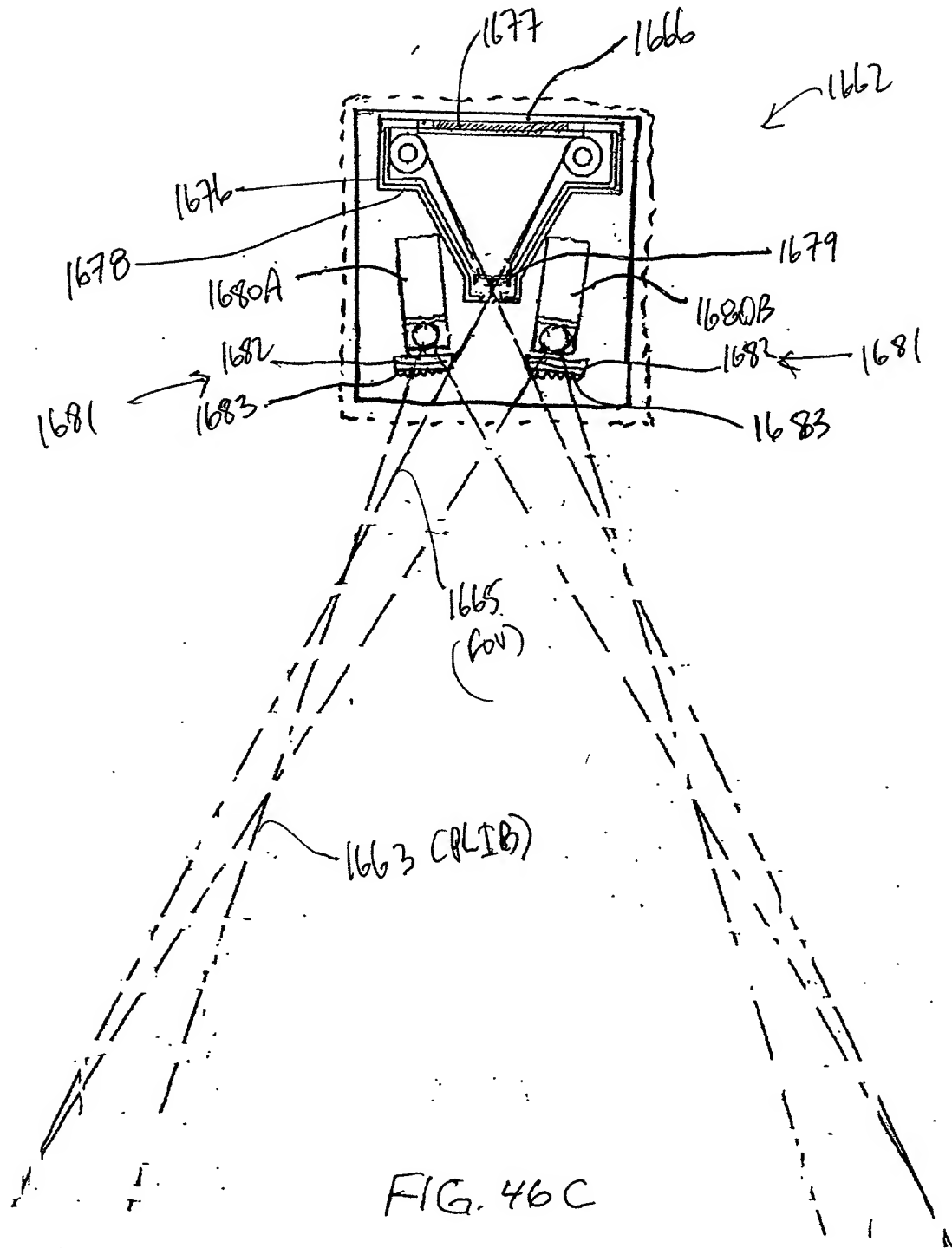


FIG. 46C

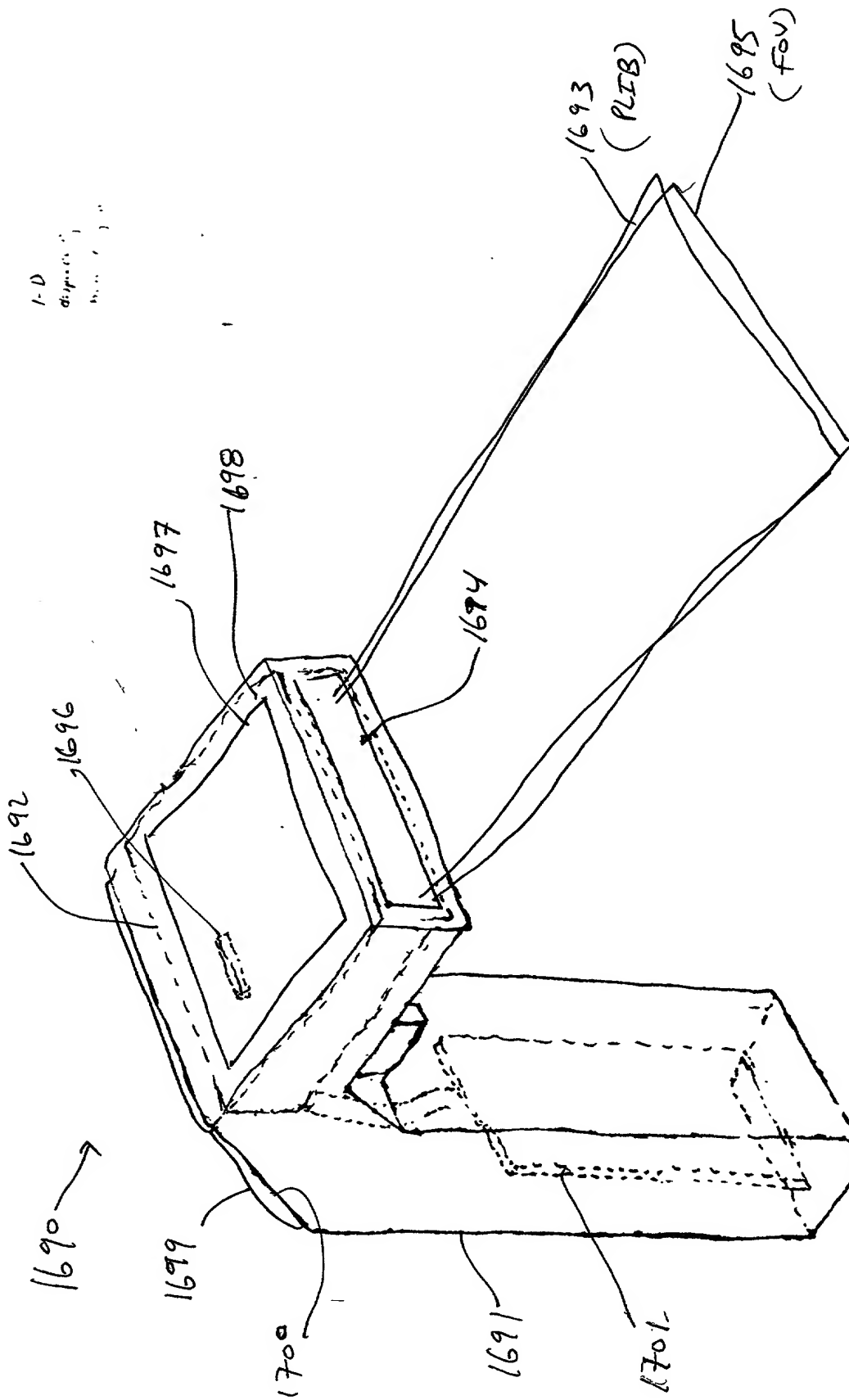
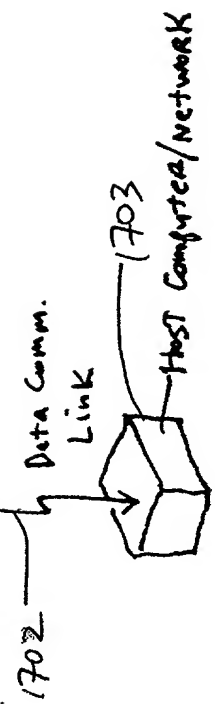


FIG. 47A



Host Computer/Network

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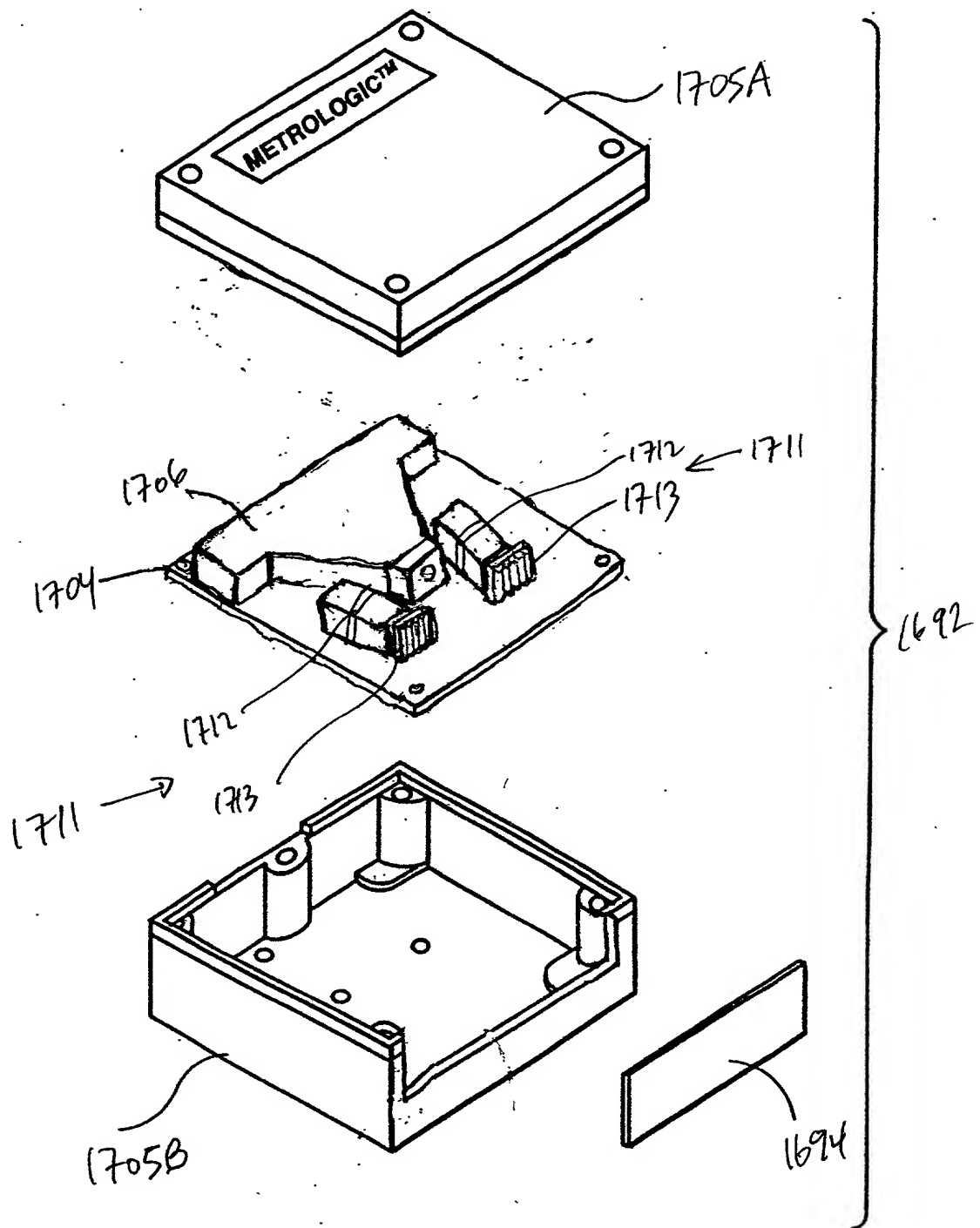


FIG. 47B

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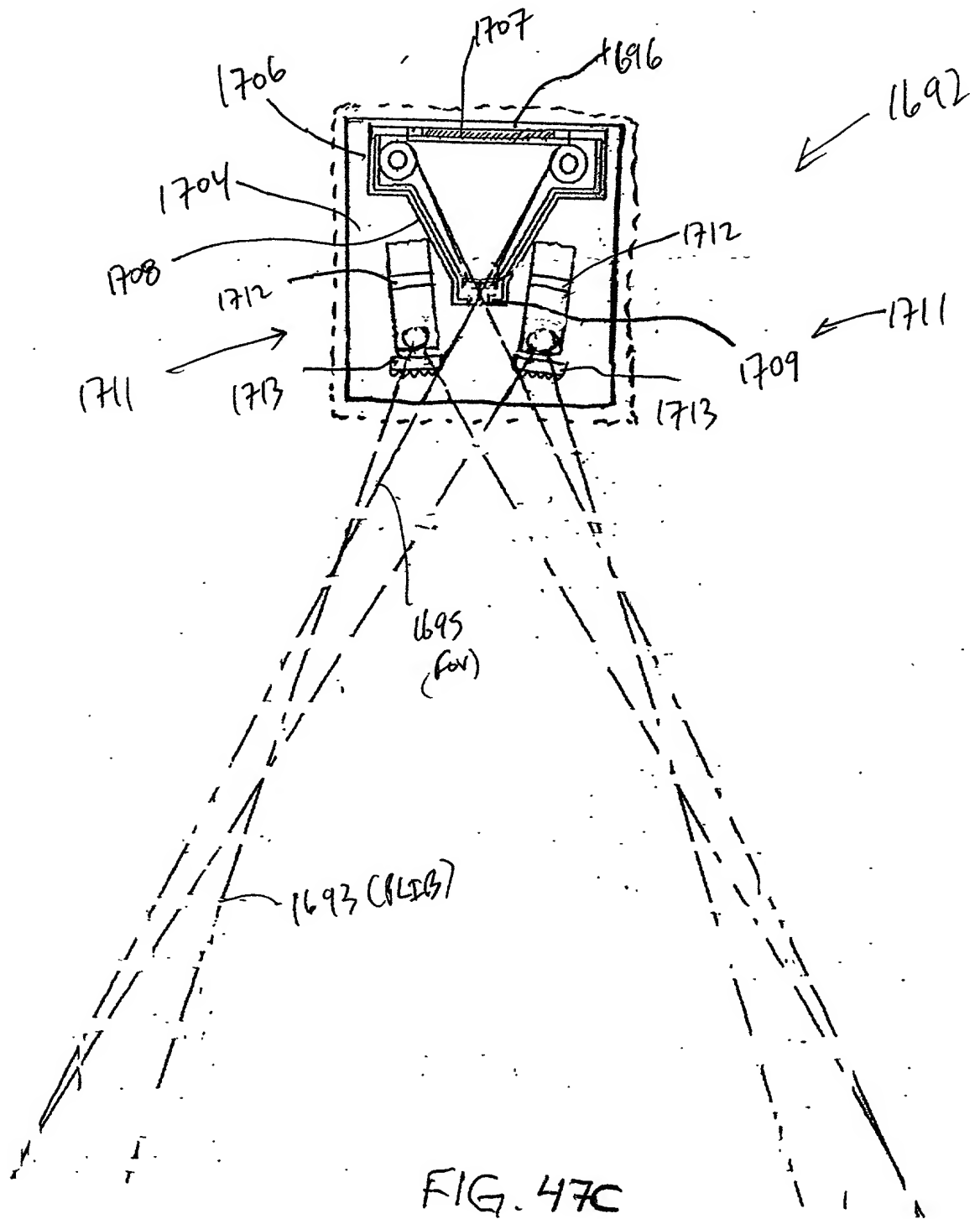
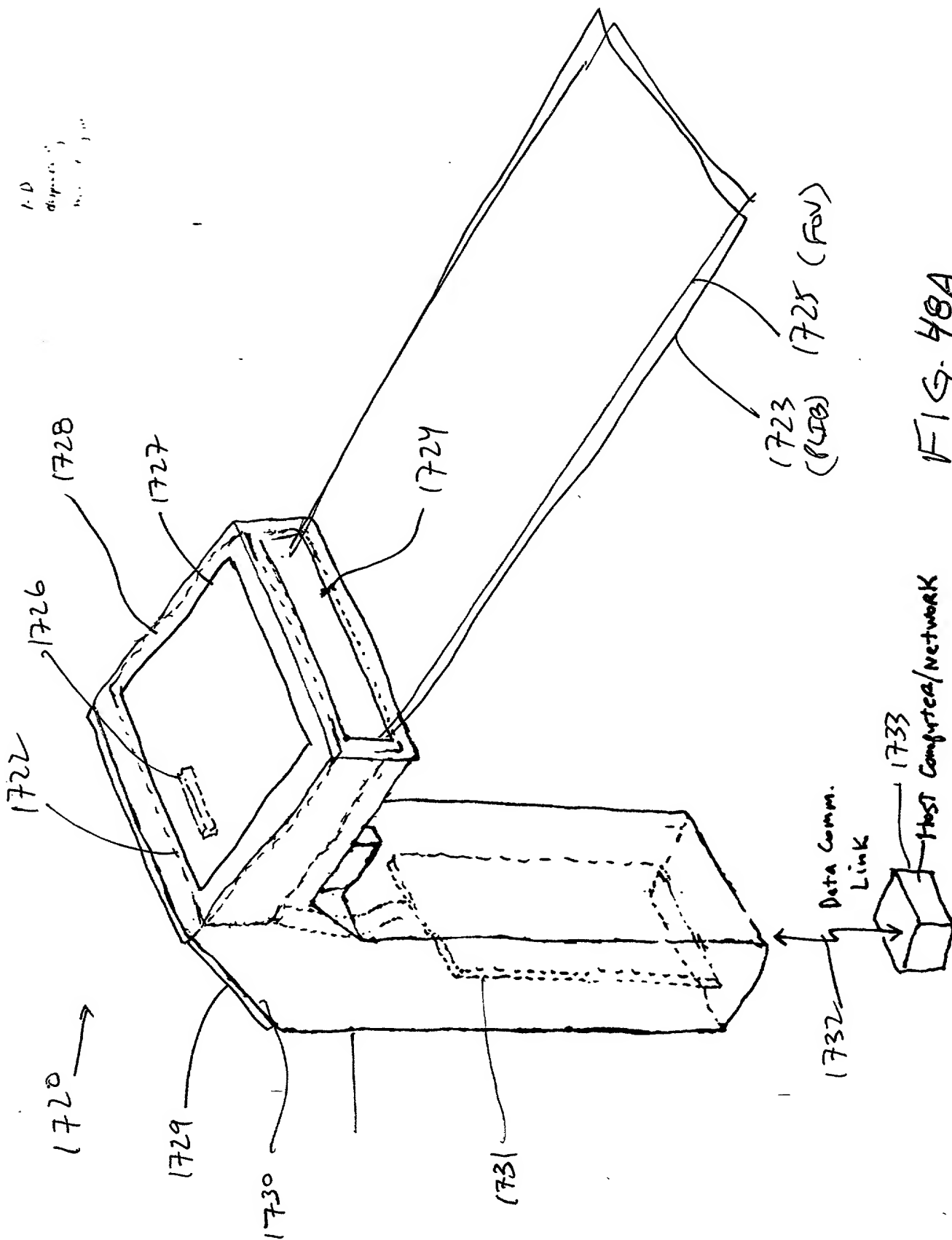


FIG. 47C

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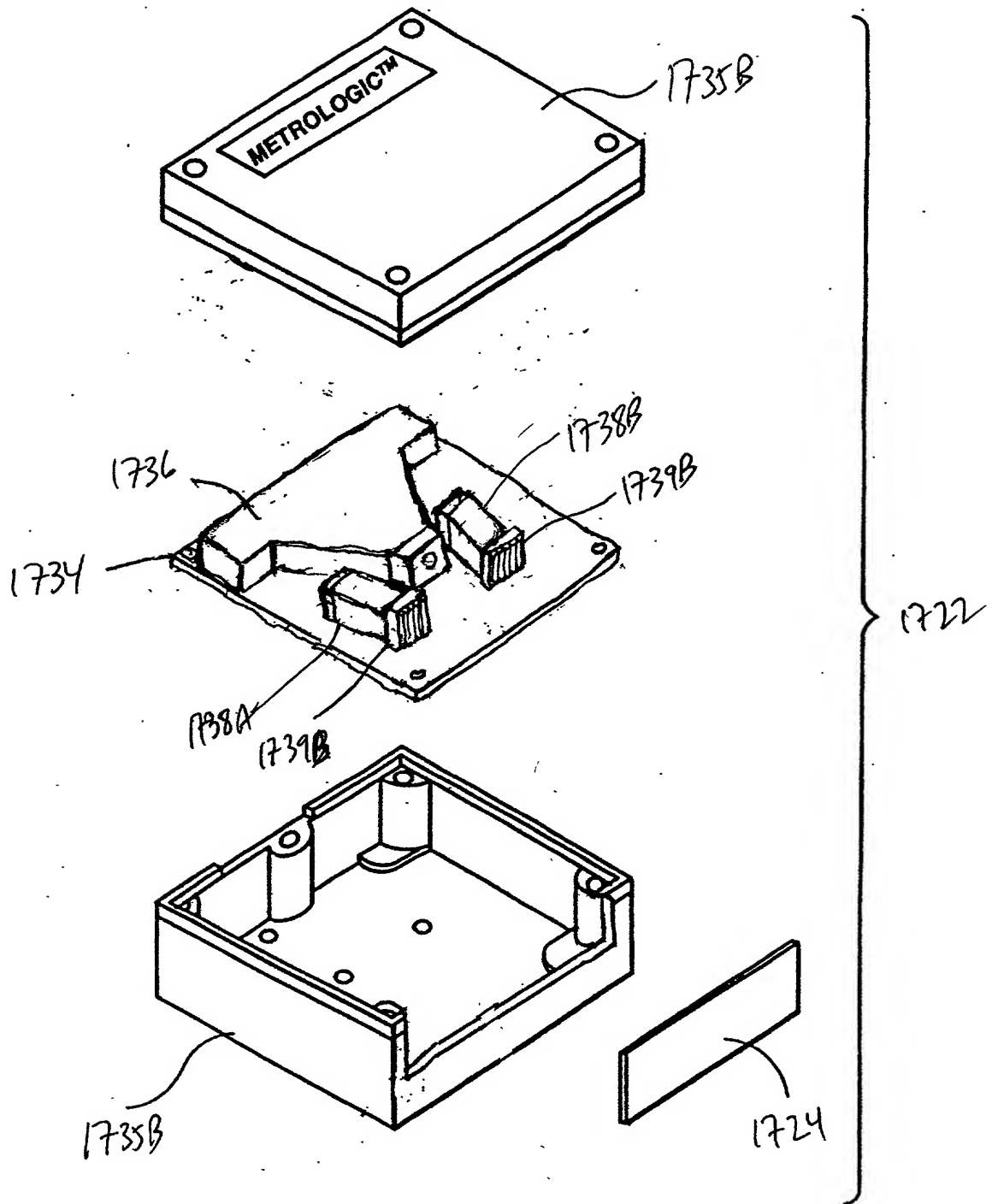
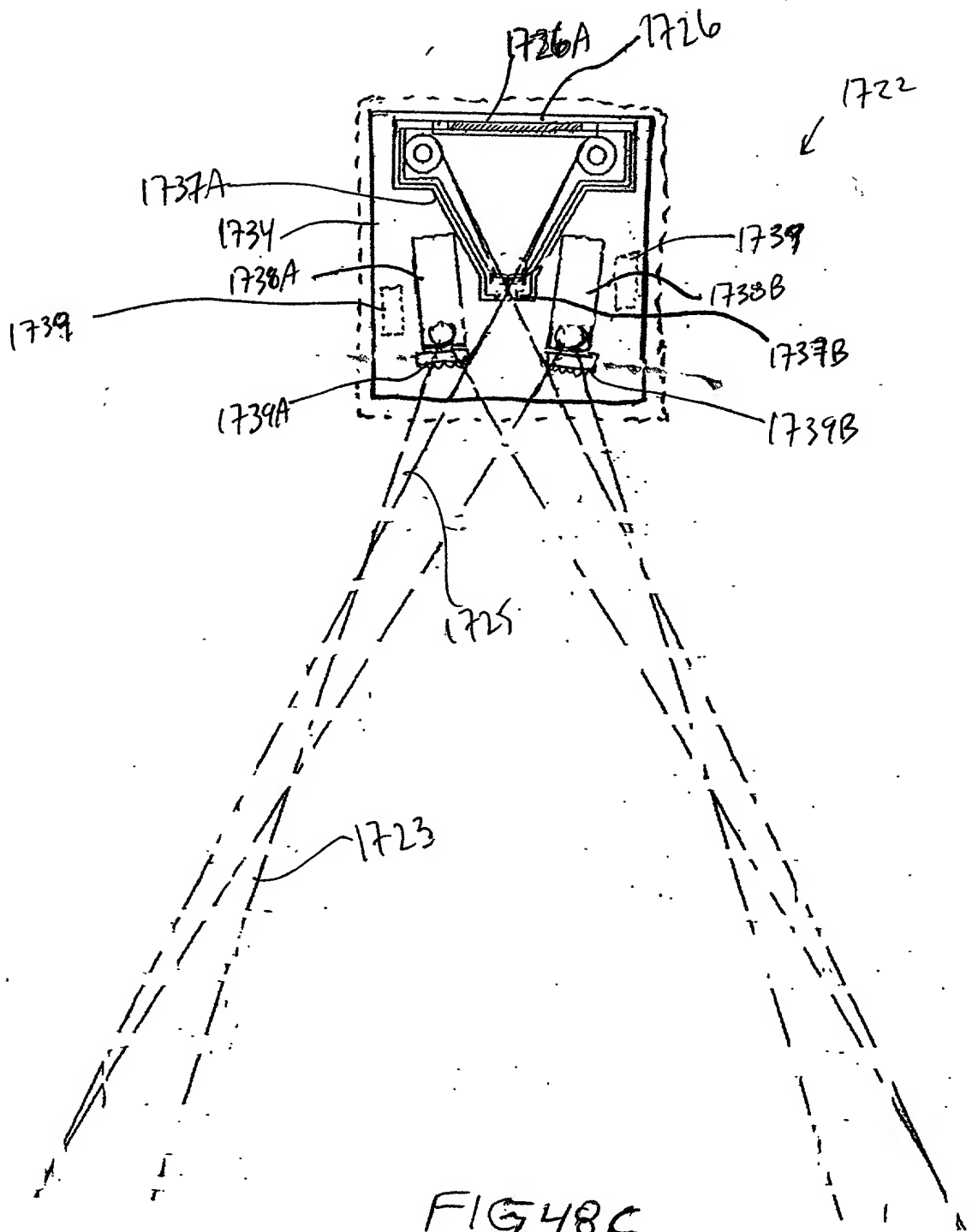


FIG. 48B

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283/332

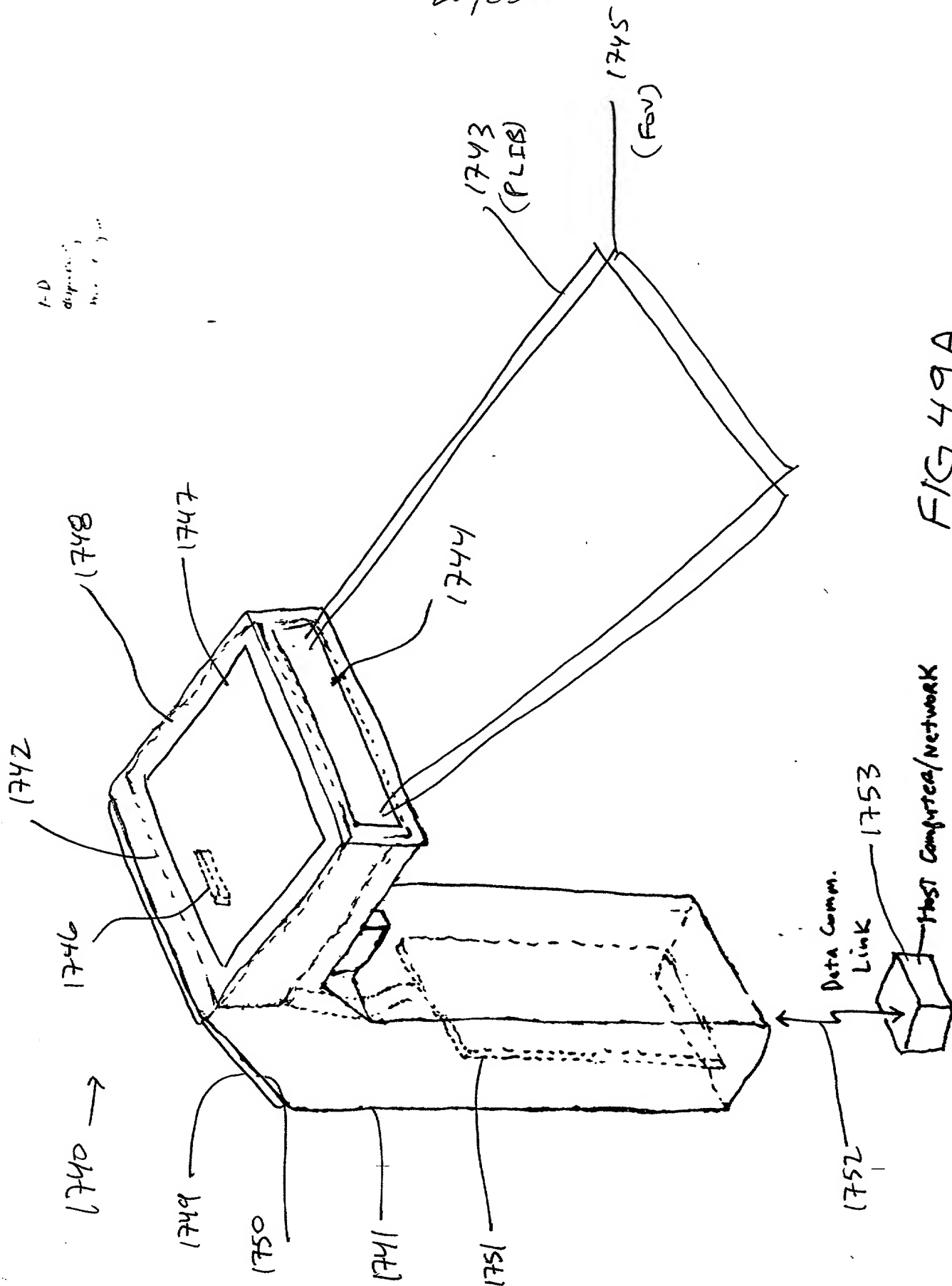


FIG. 49A

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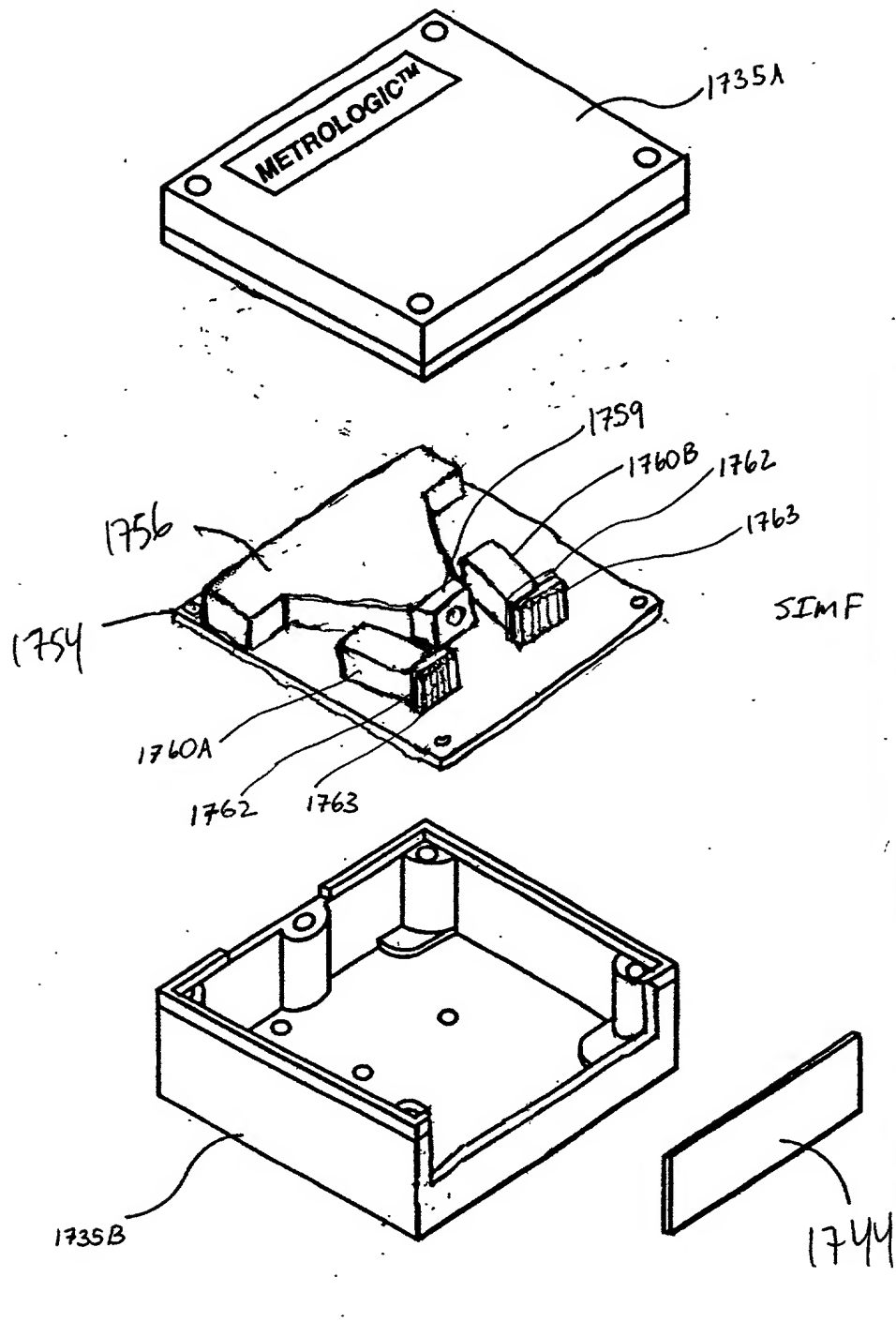


FIG. 49B

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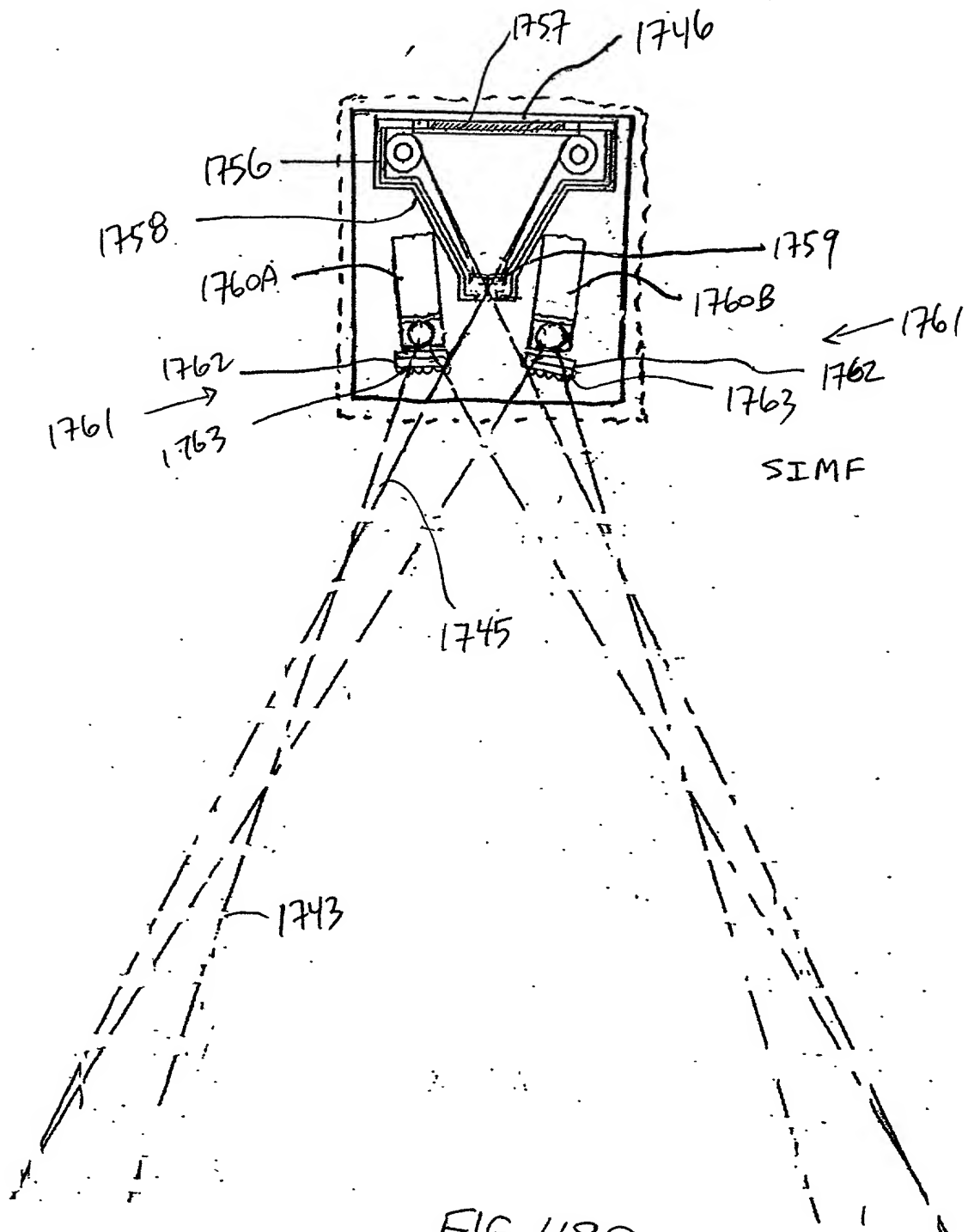


FIG. 49C

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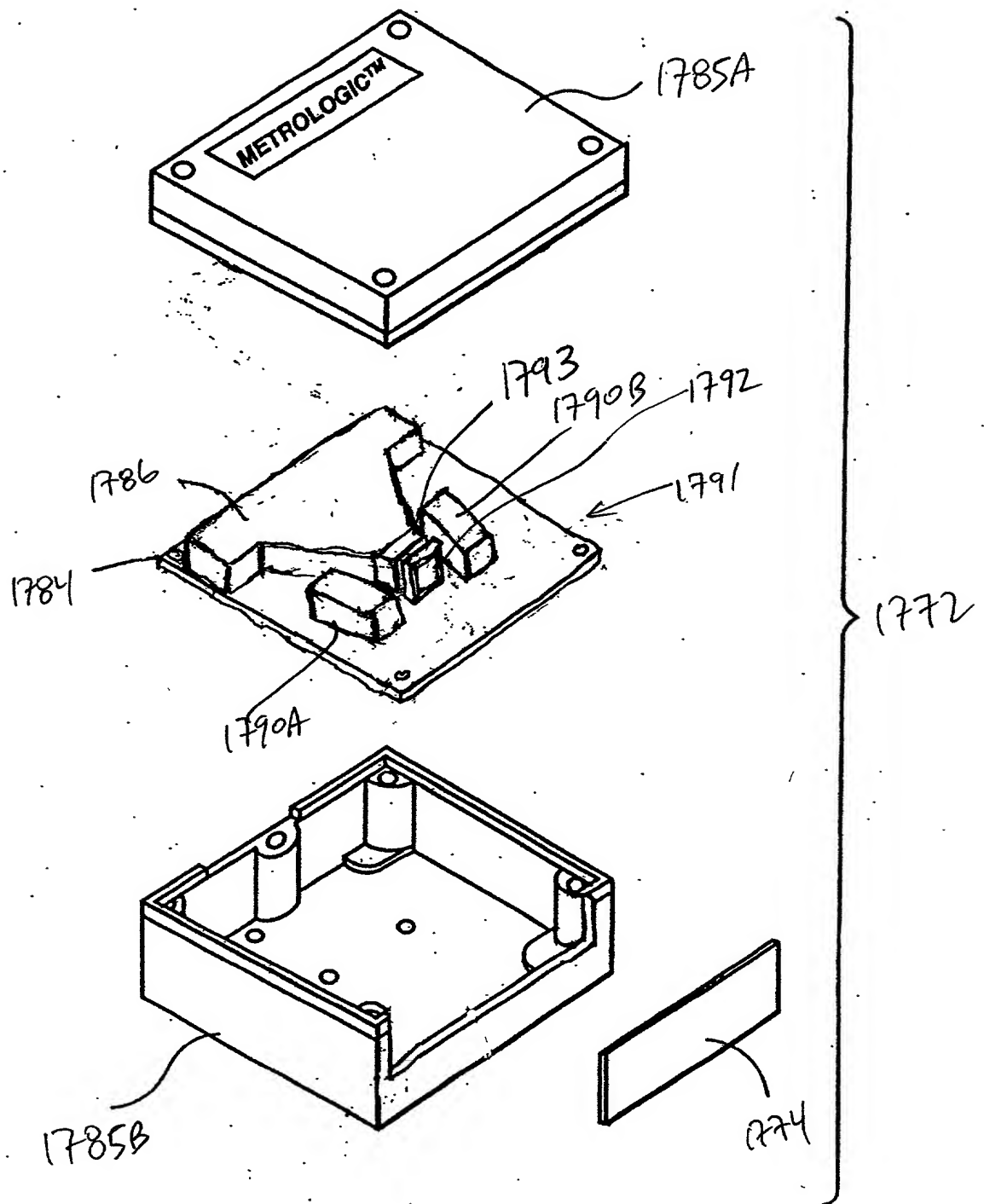
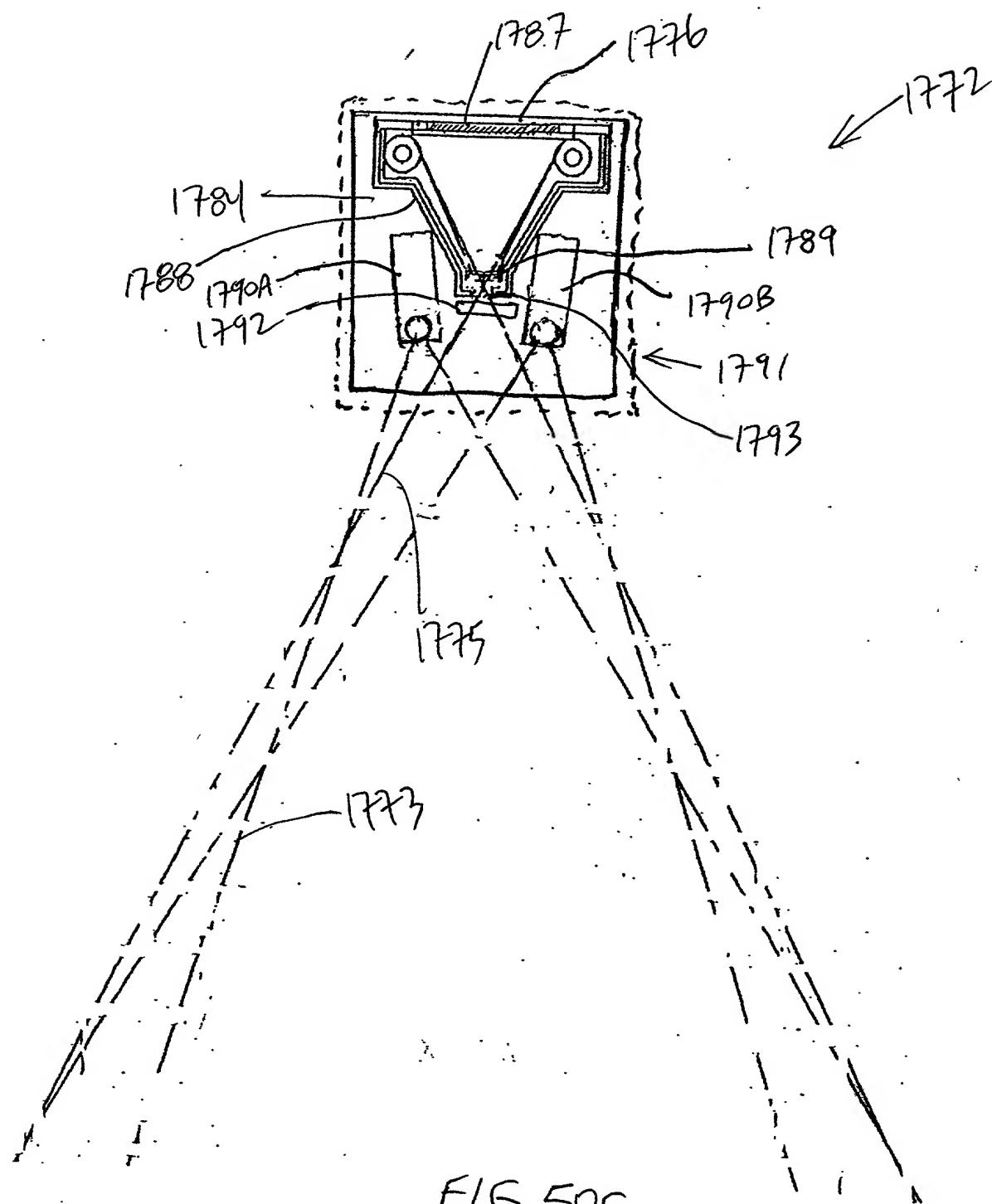


FIG. 50B

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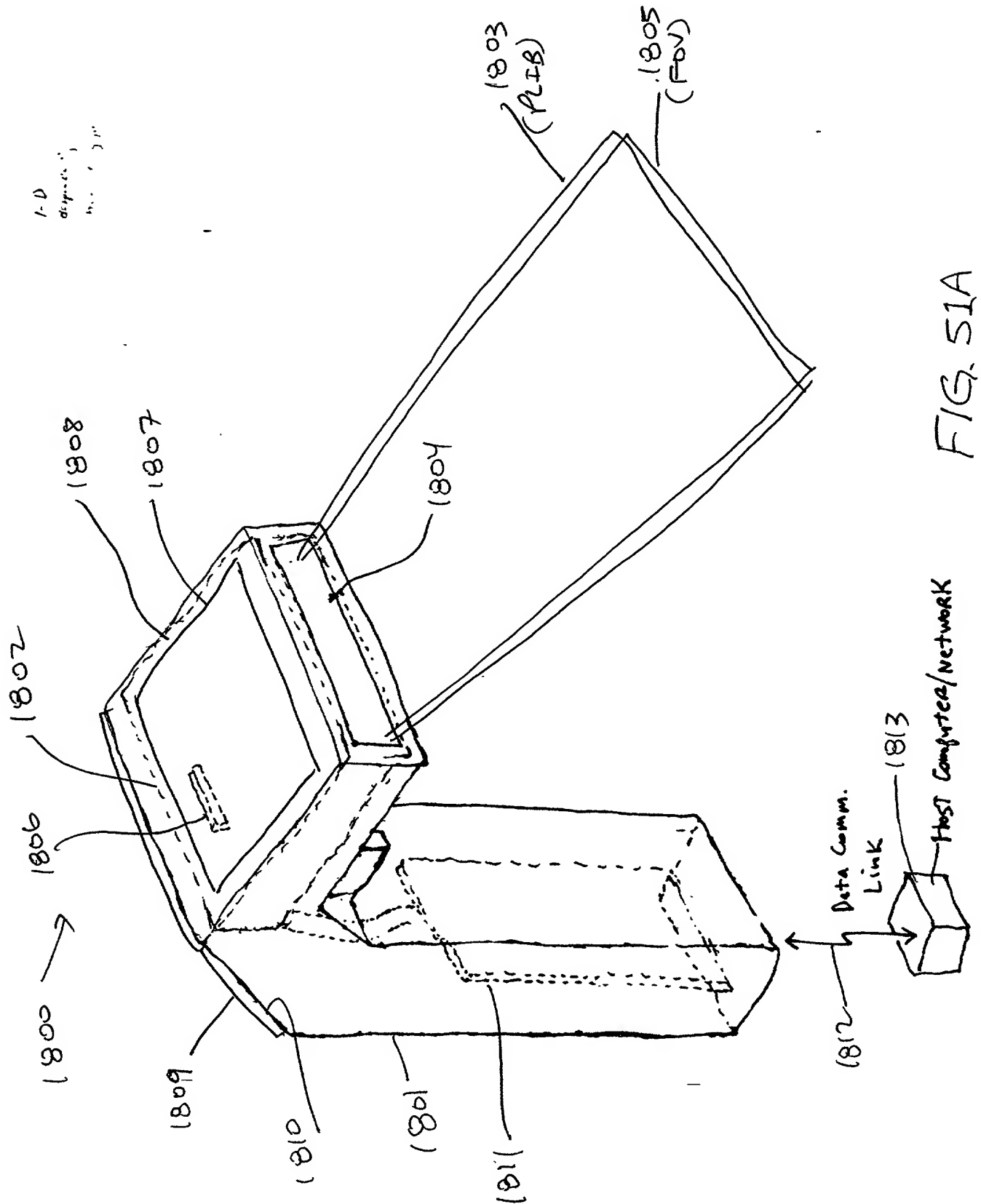


FIG. 51A

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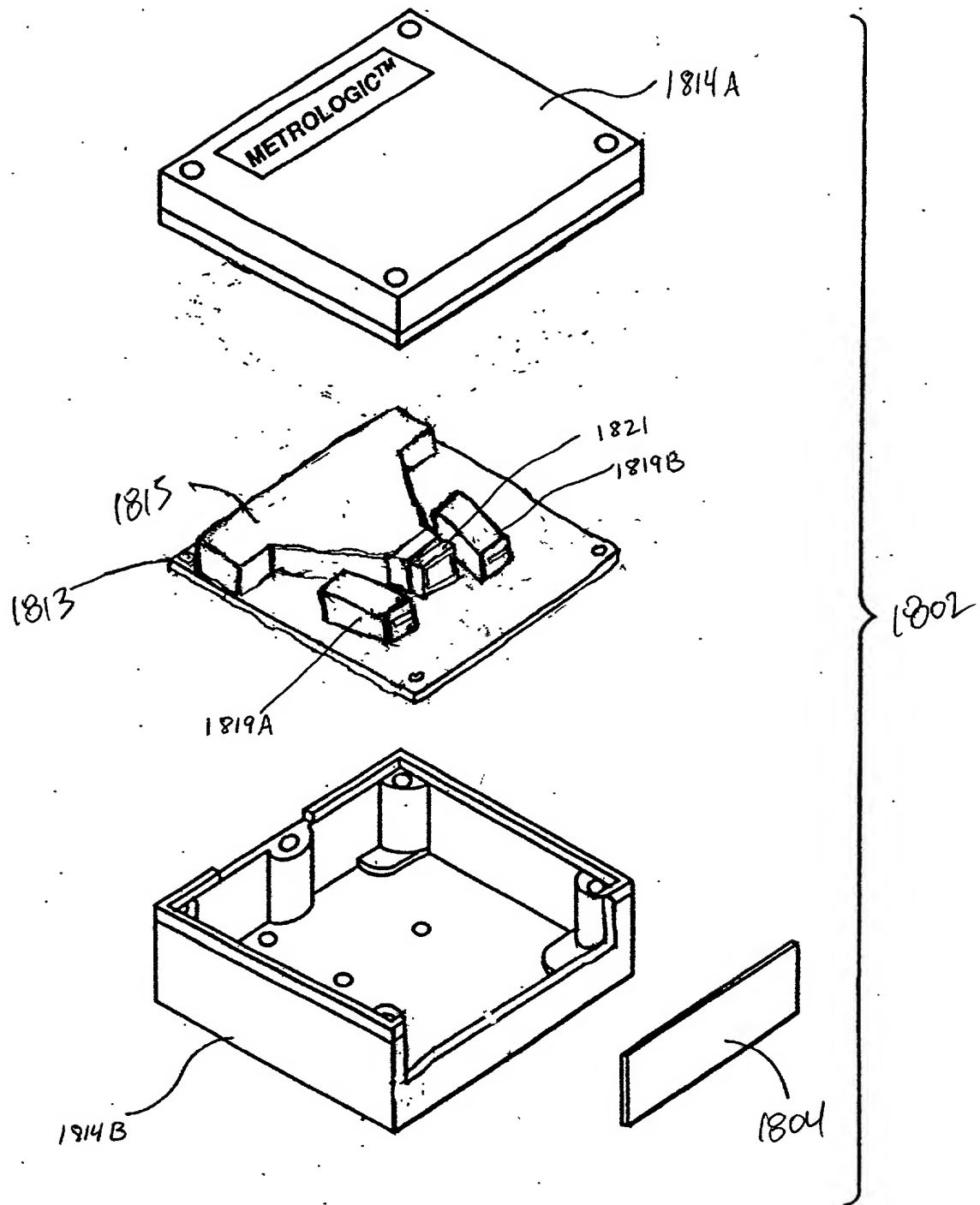


FIG. 51B

[illegible]

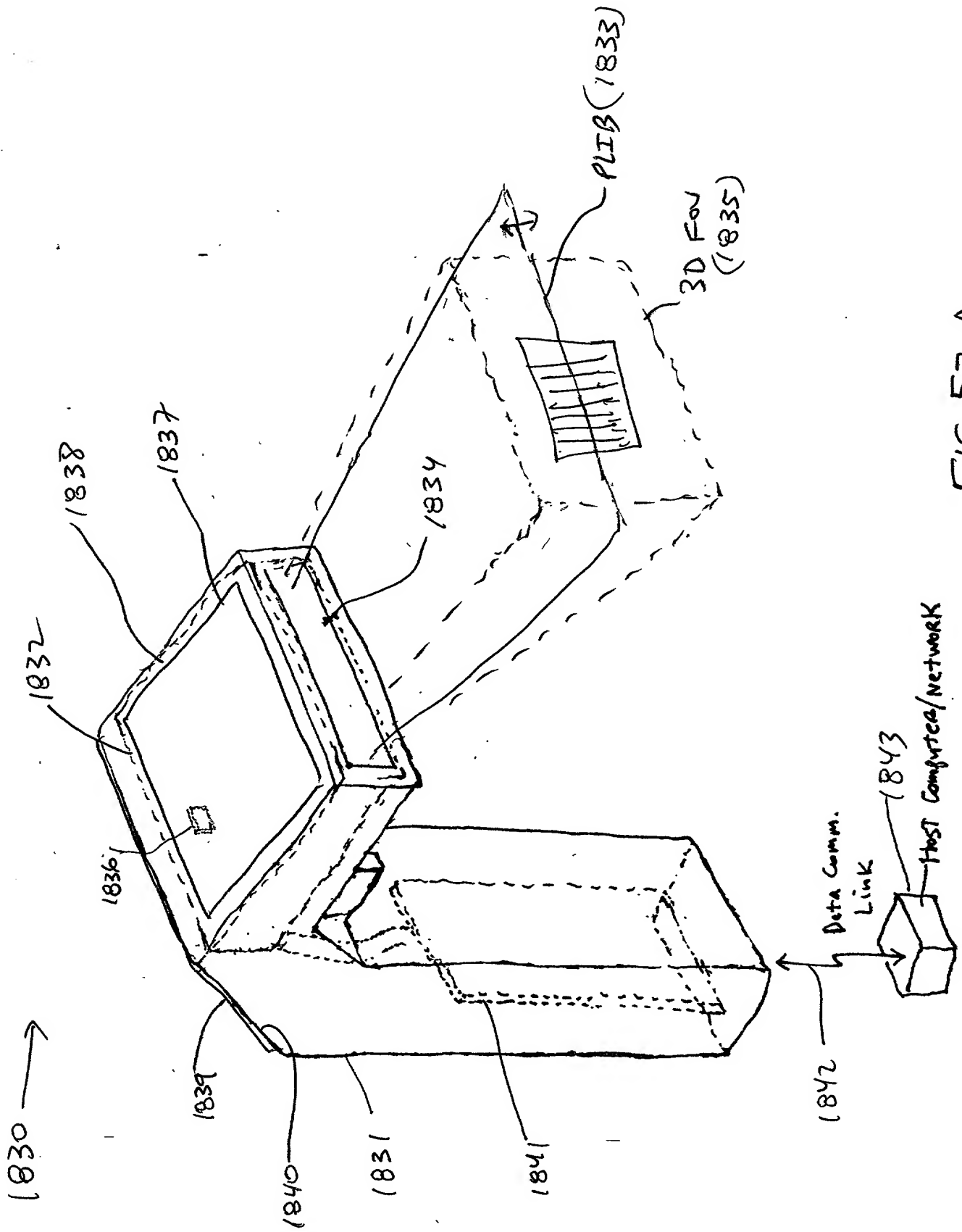


FIG. 52A

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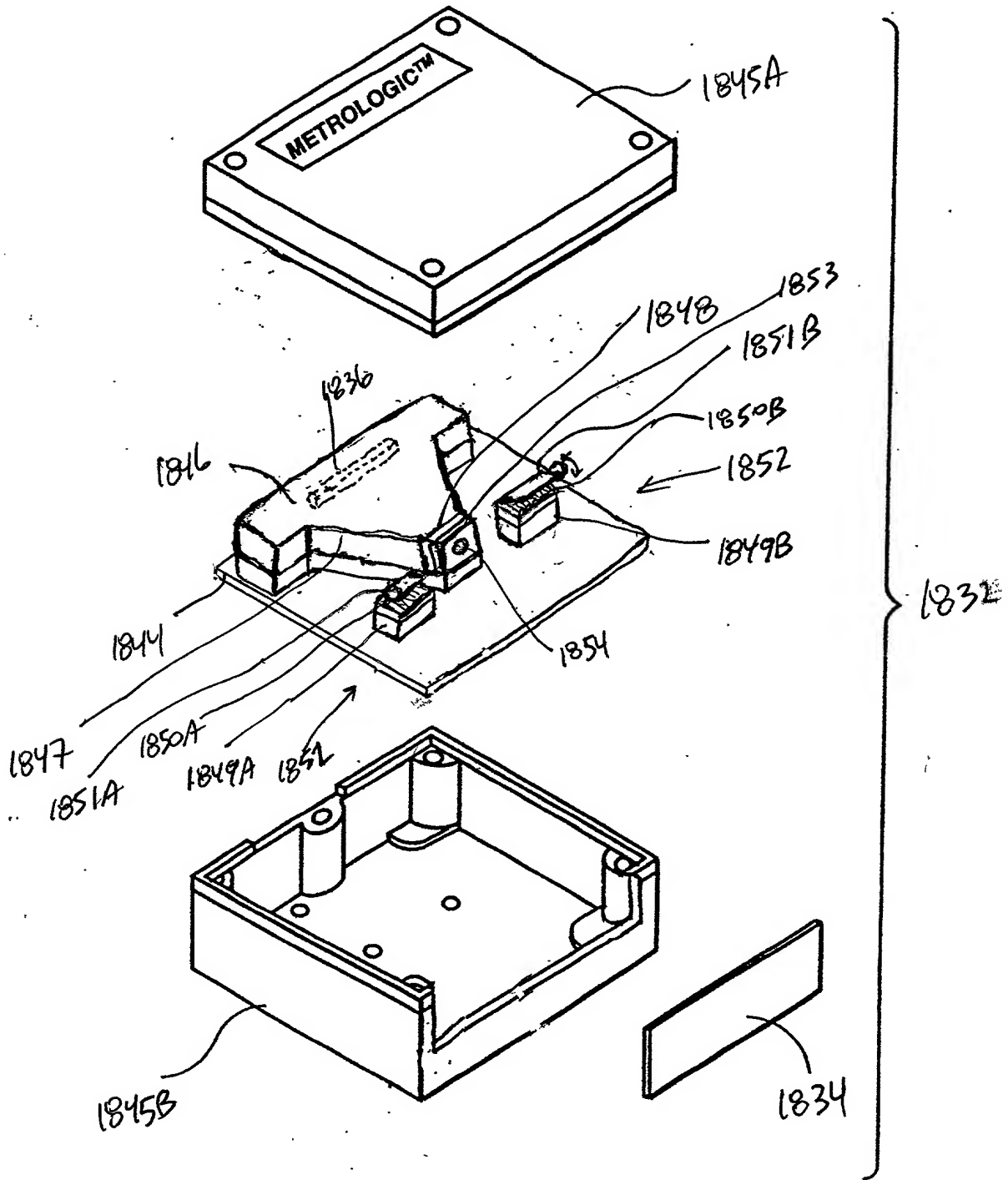


FIG. 52B

Fig. 1I 3A-3B

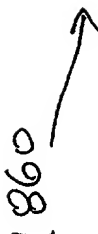
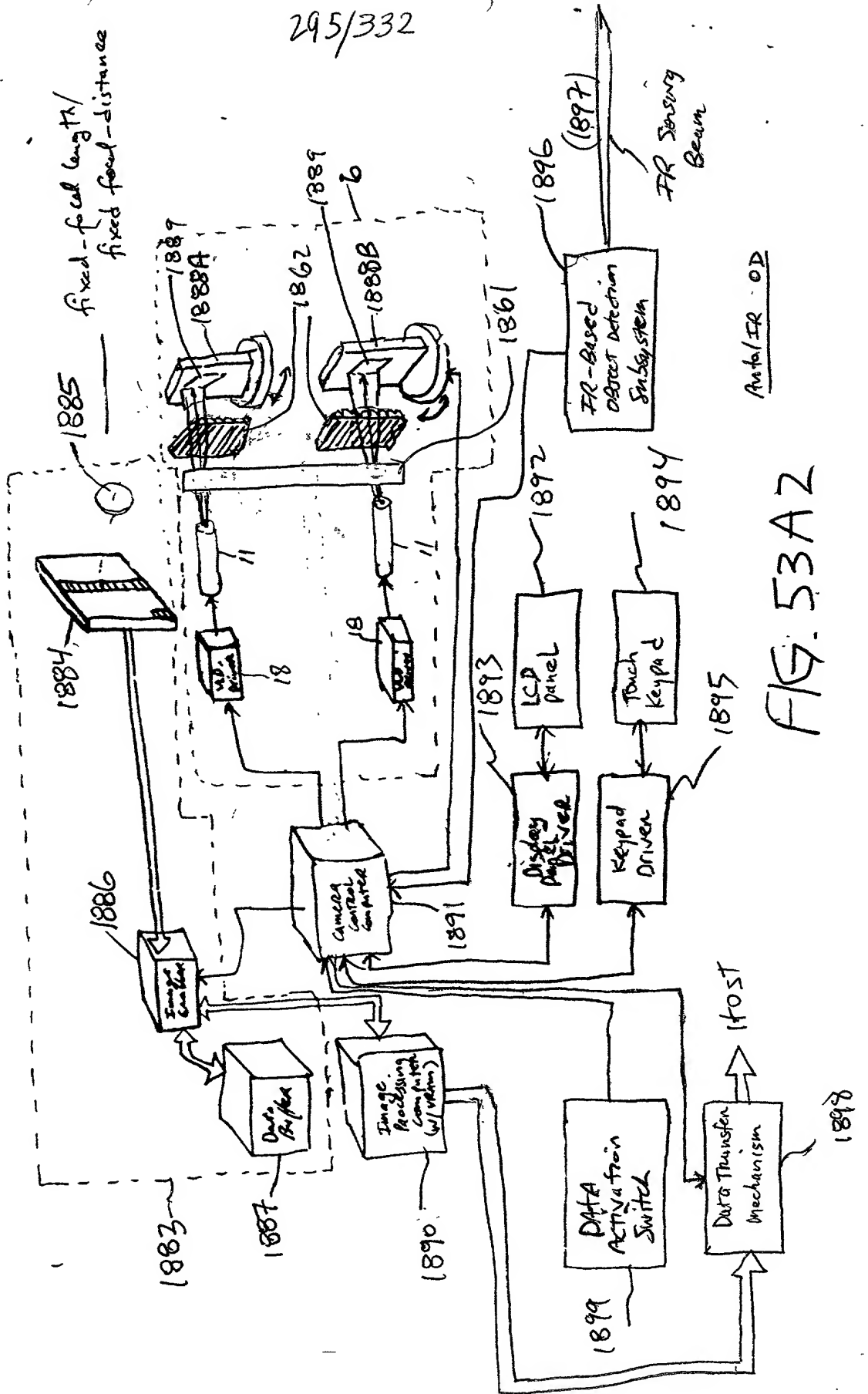


FIG. 53A1

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1880



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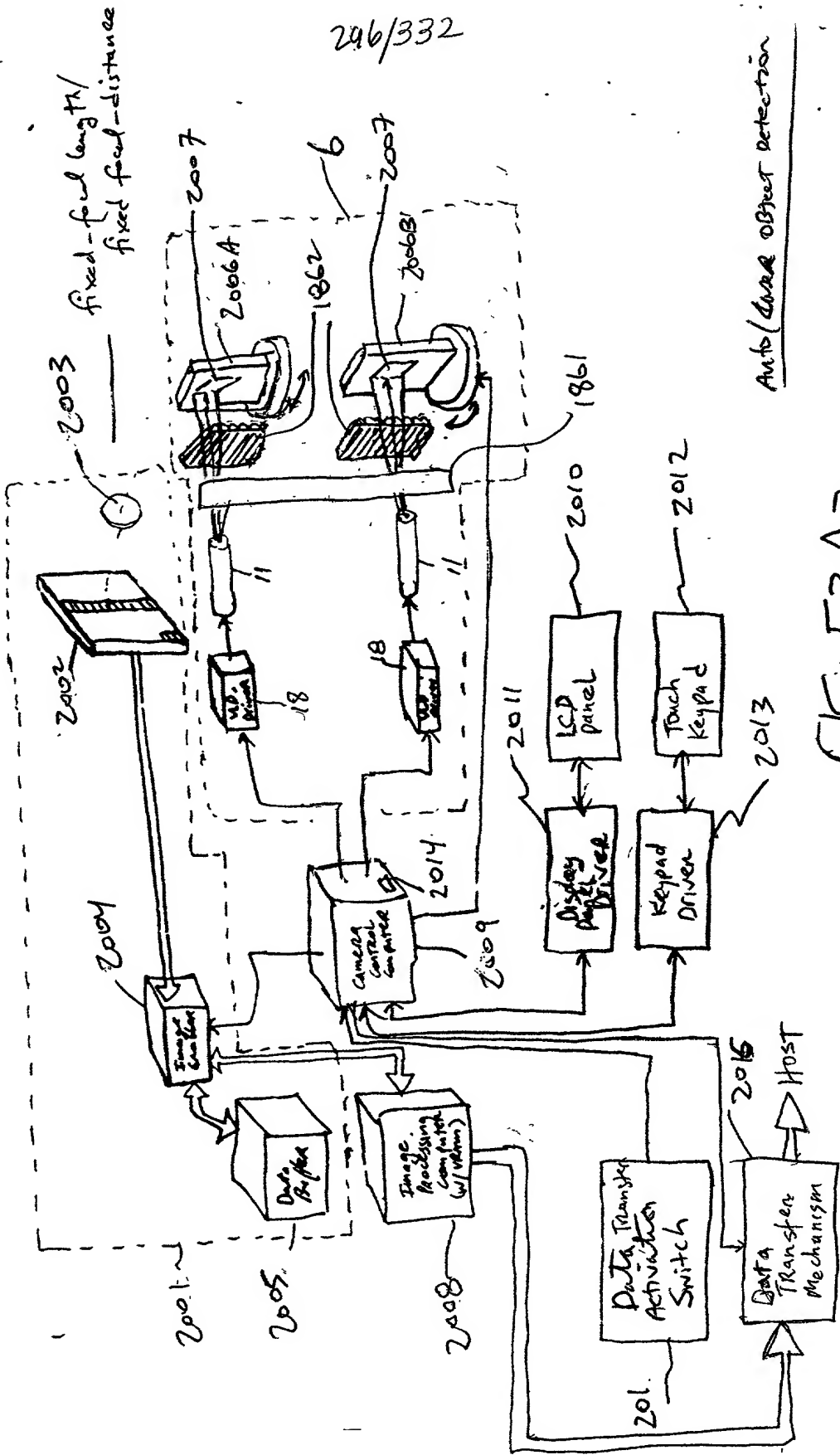


FIG. 53A3

20002

2020

2020

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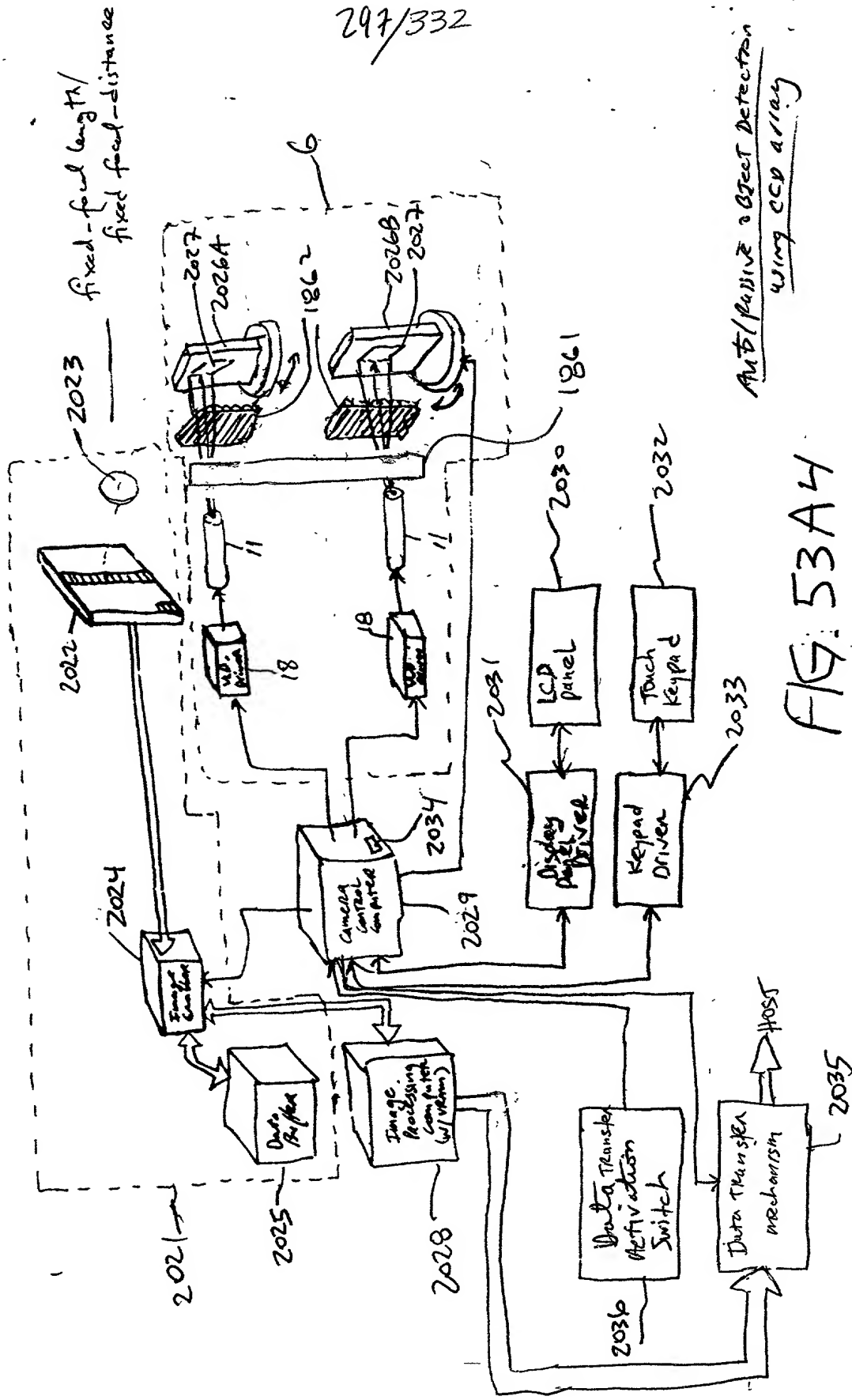


FIG. 53A4

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Auto / BCD only / no object
Detection

2040

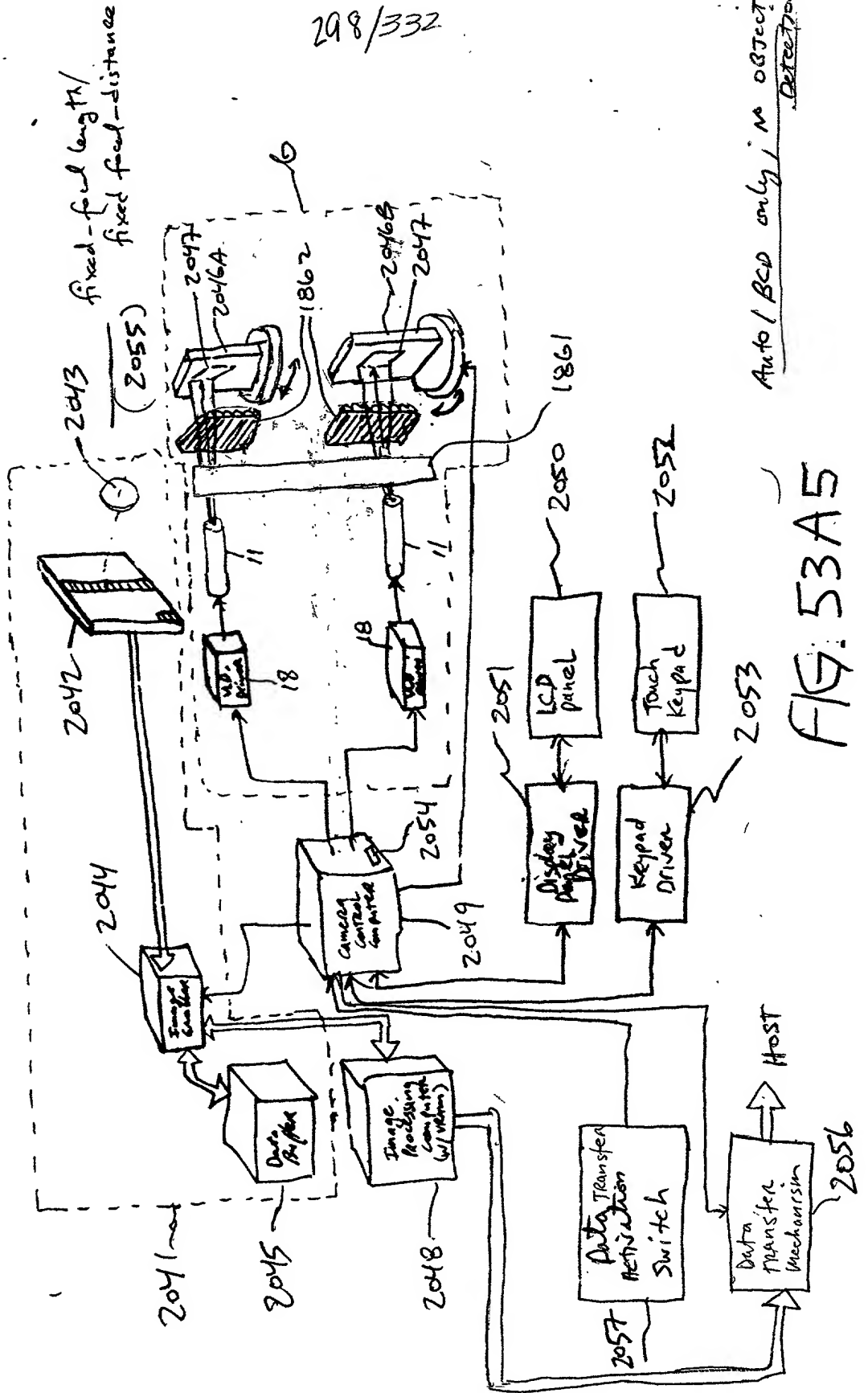


FIG. 53A5

2060 →

fixed focal length/
variable focal distance

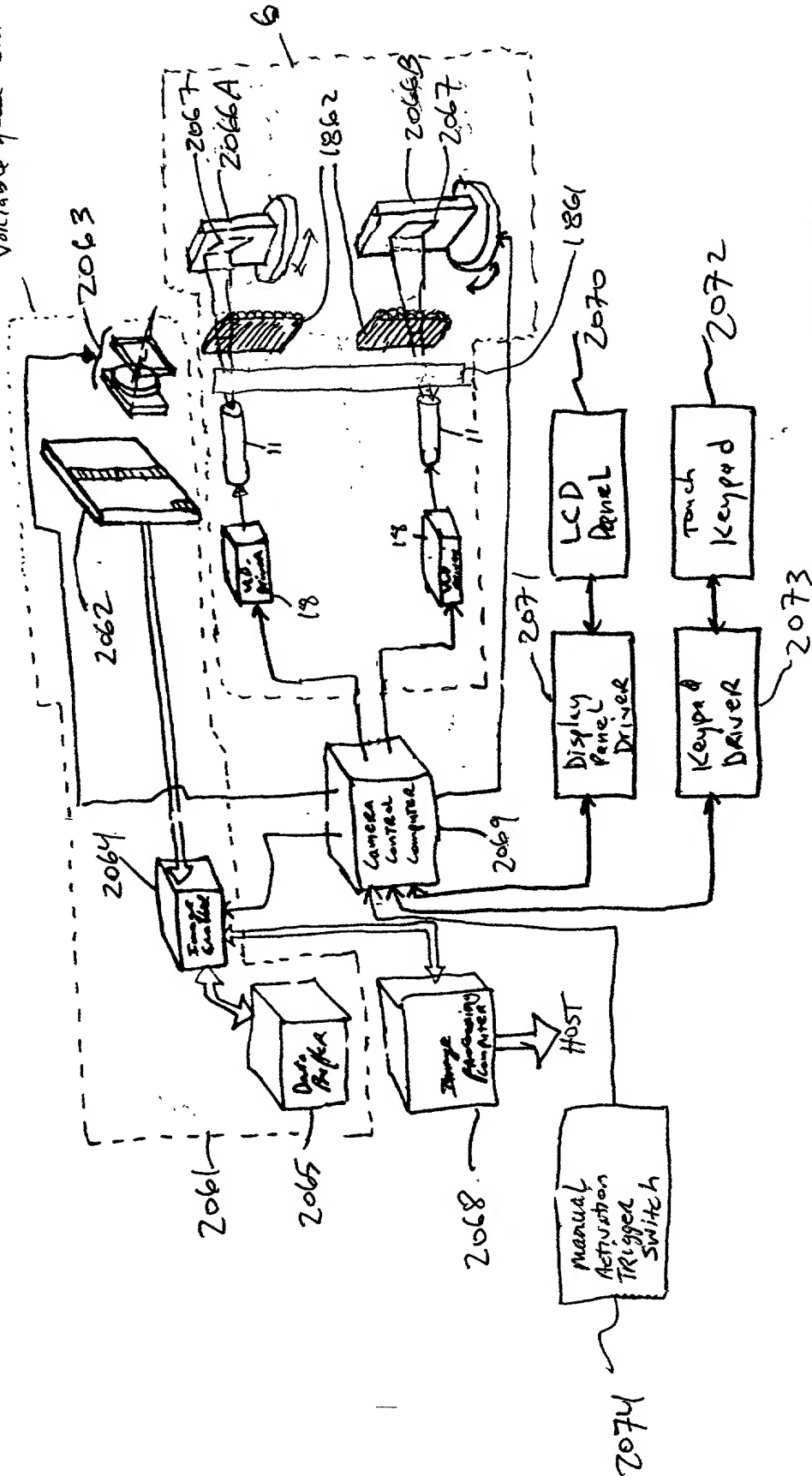


FIG. 53B1

Manual

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30

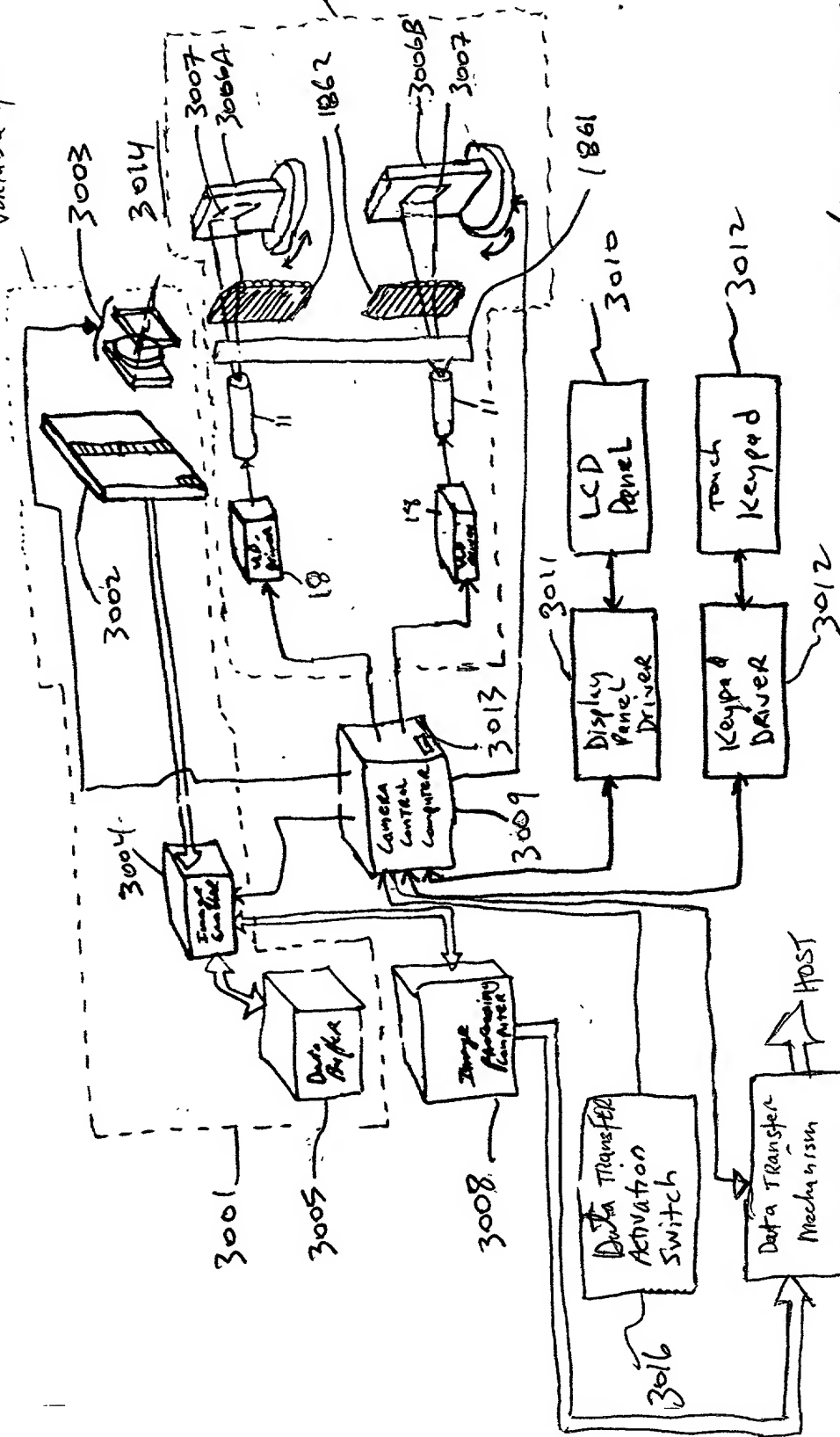
5



2096

3000

fixed focal length/
variable focal distance



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Auto/Manual Object Detection

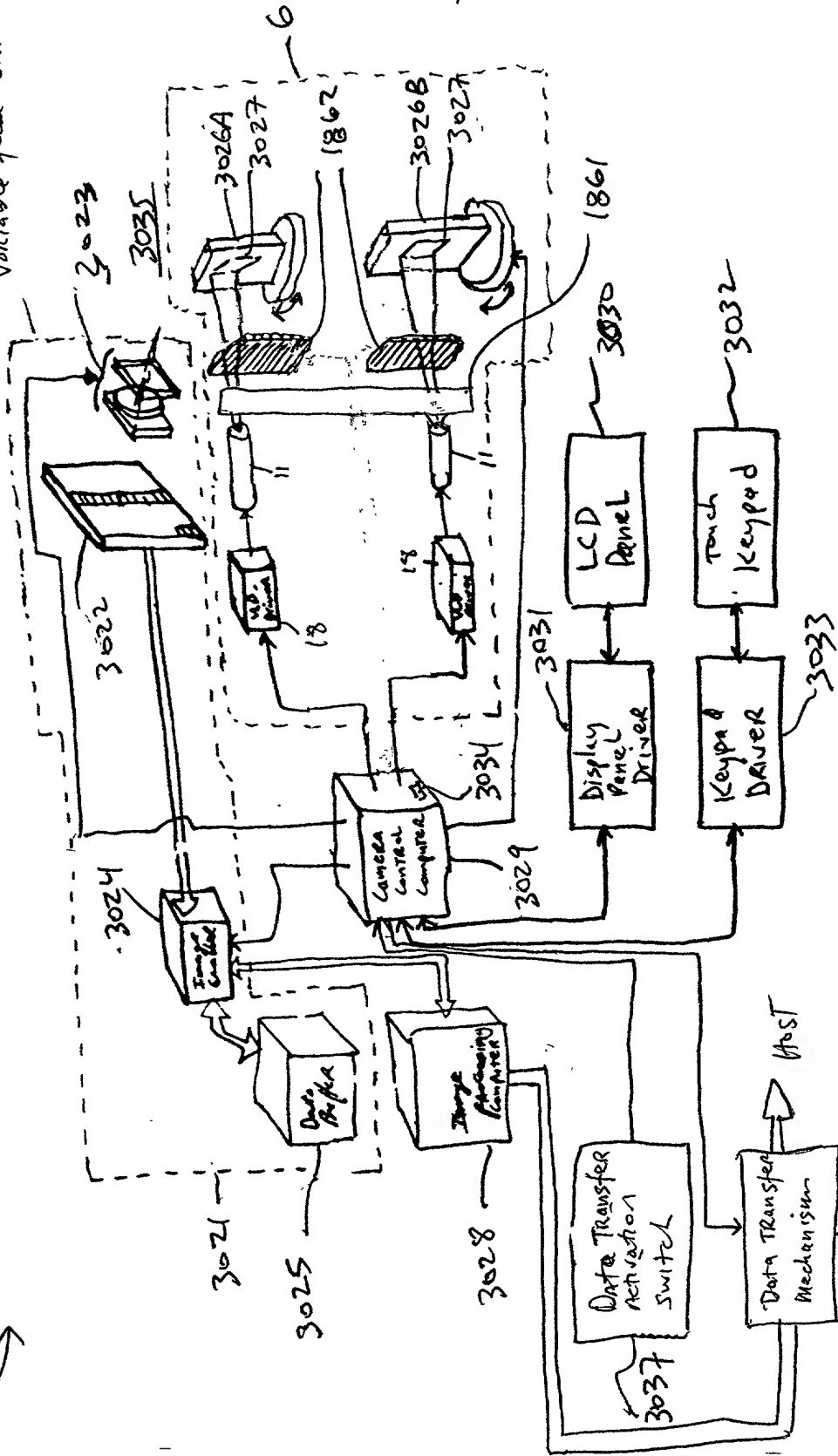
FIG. 53B3

3015

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3020

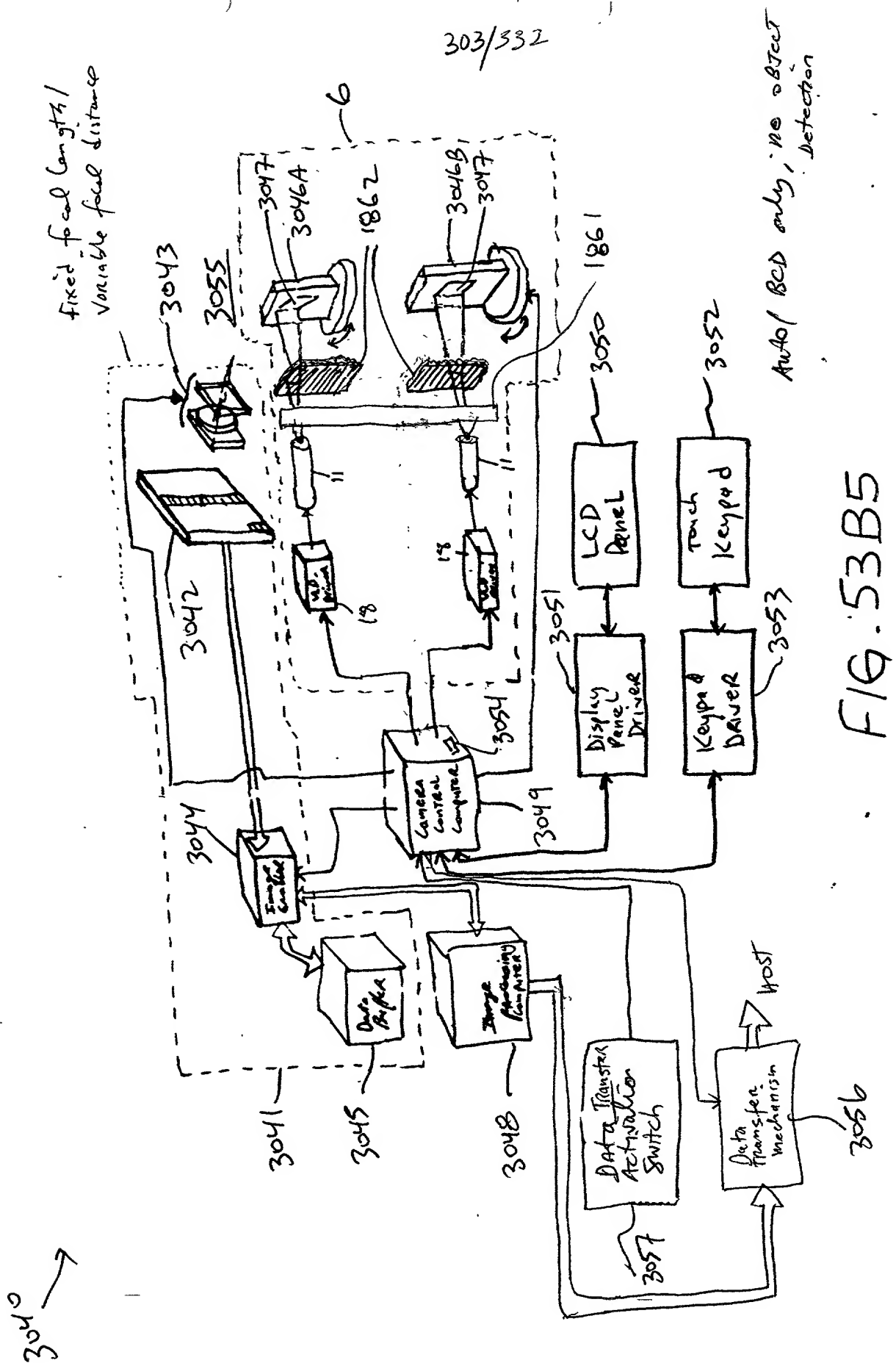
fixed focal length/
variable focal distance



Auto / Passive Object Detection
using CCD array

FIG. 53B4

3036



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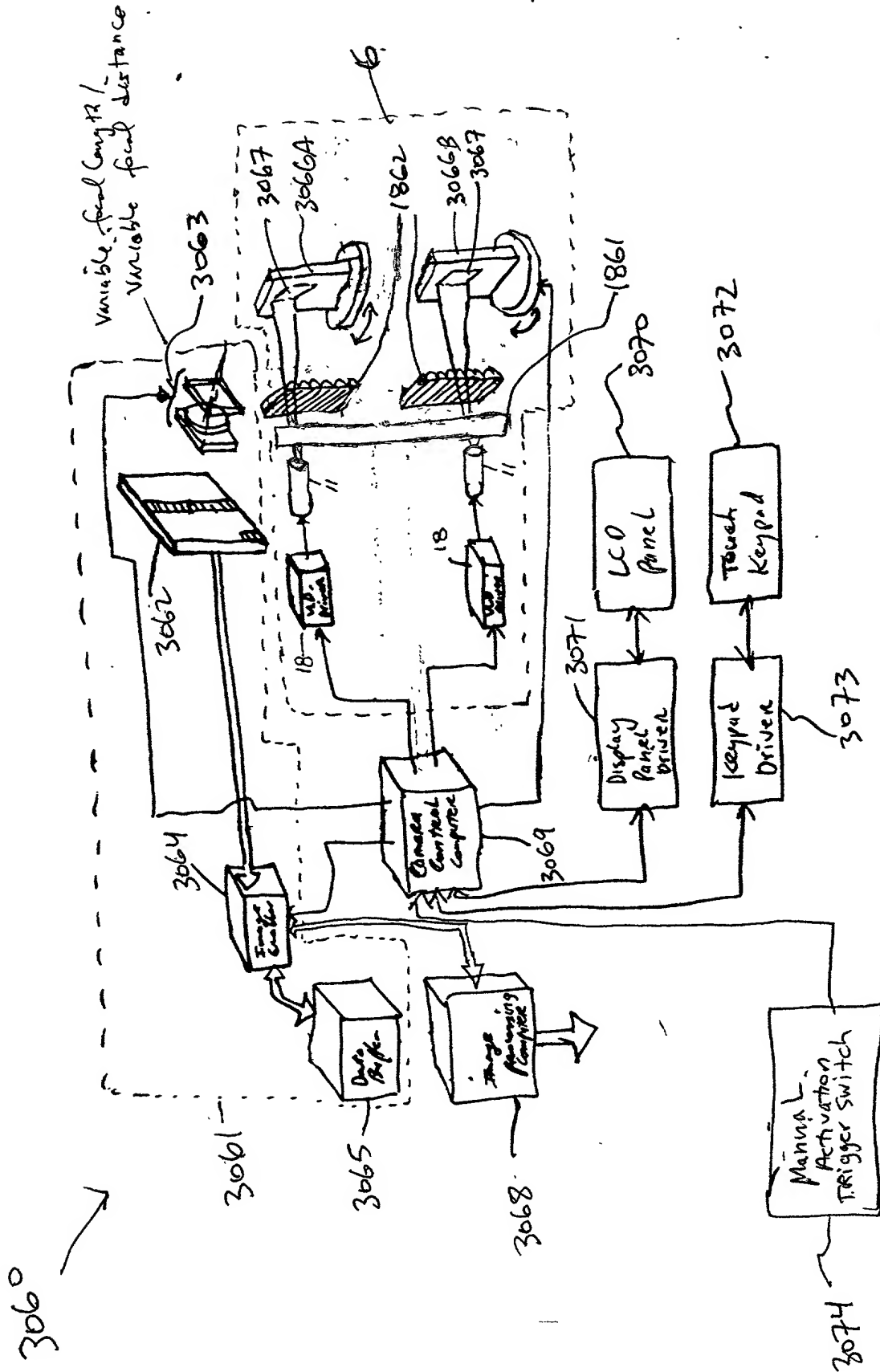
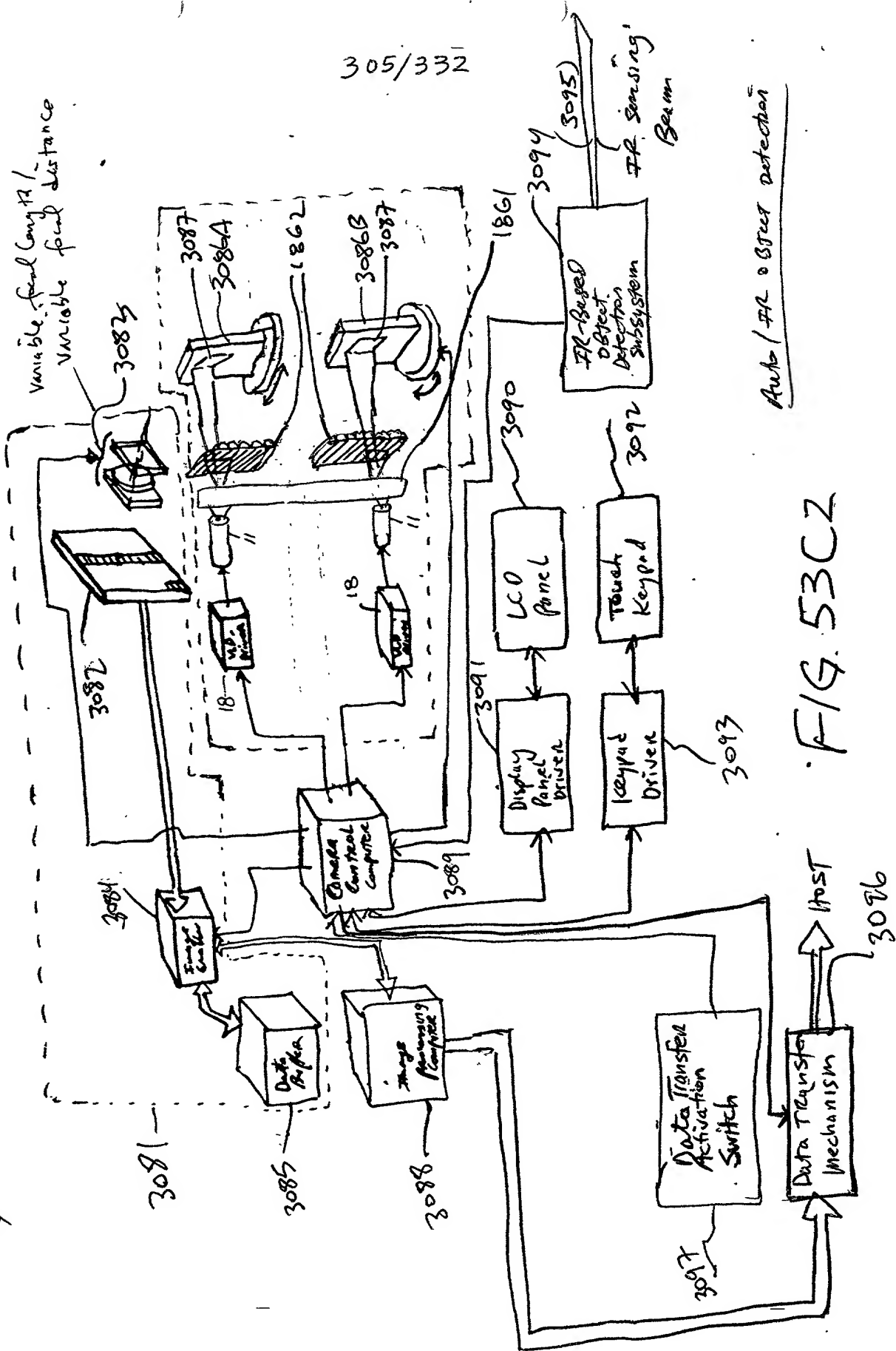


FIG. 53C1

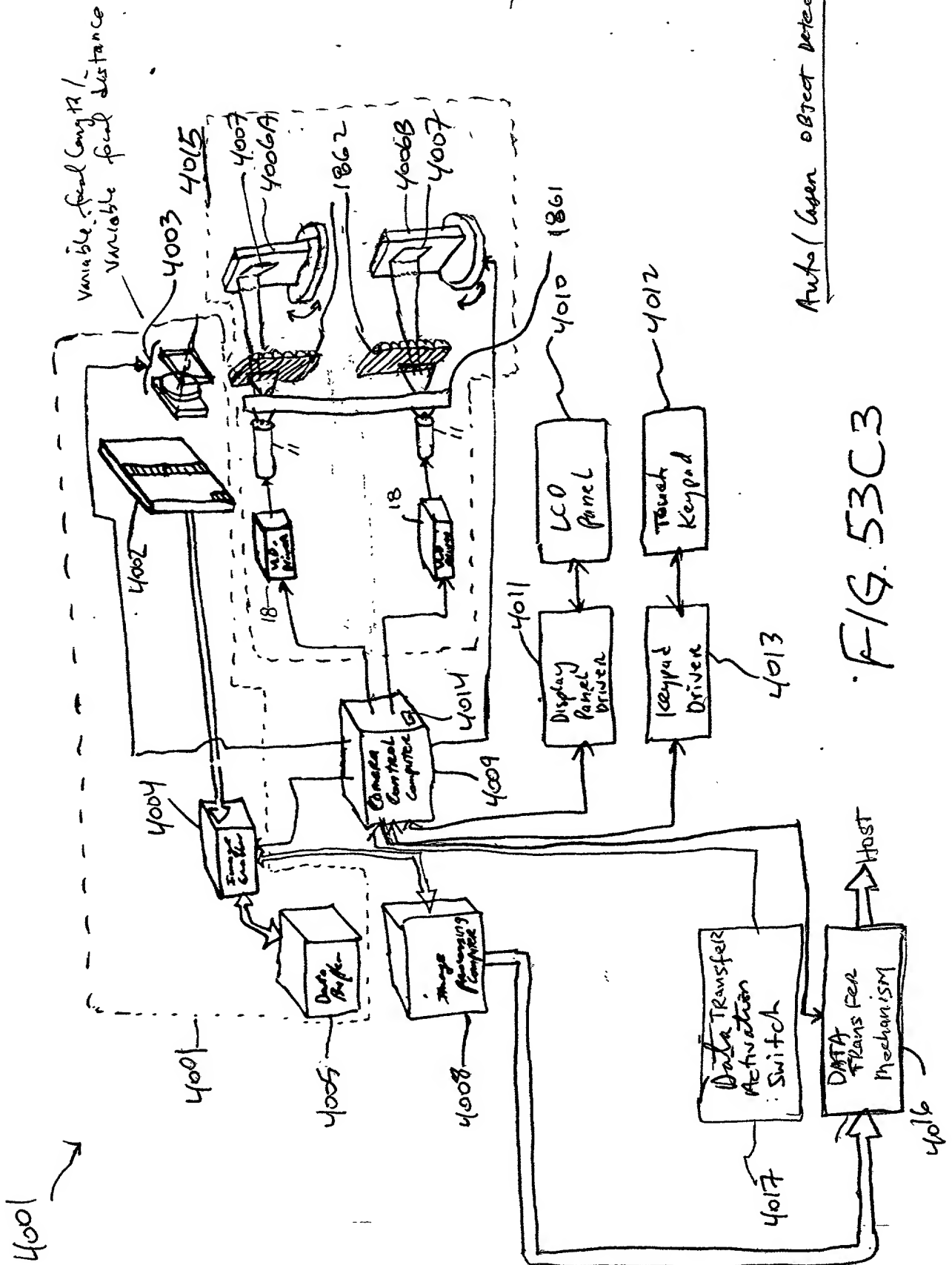
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3080 →



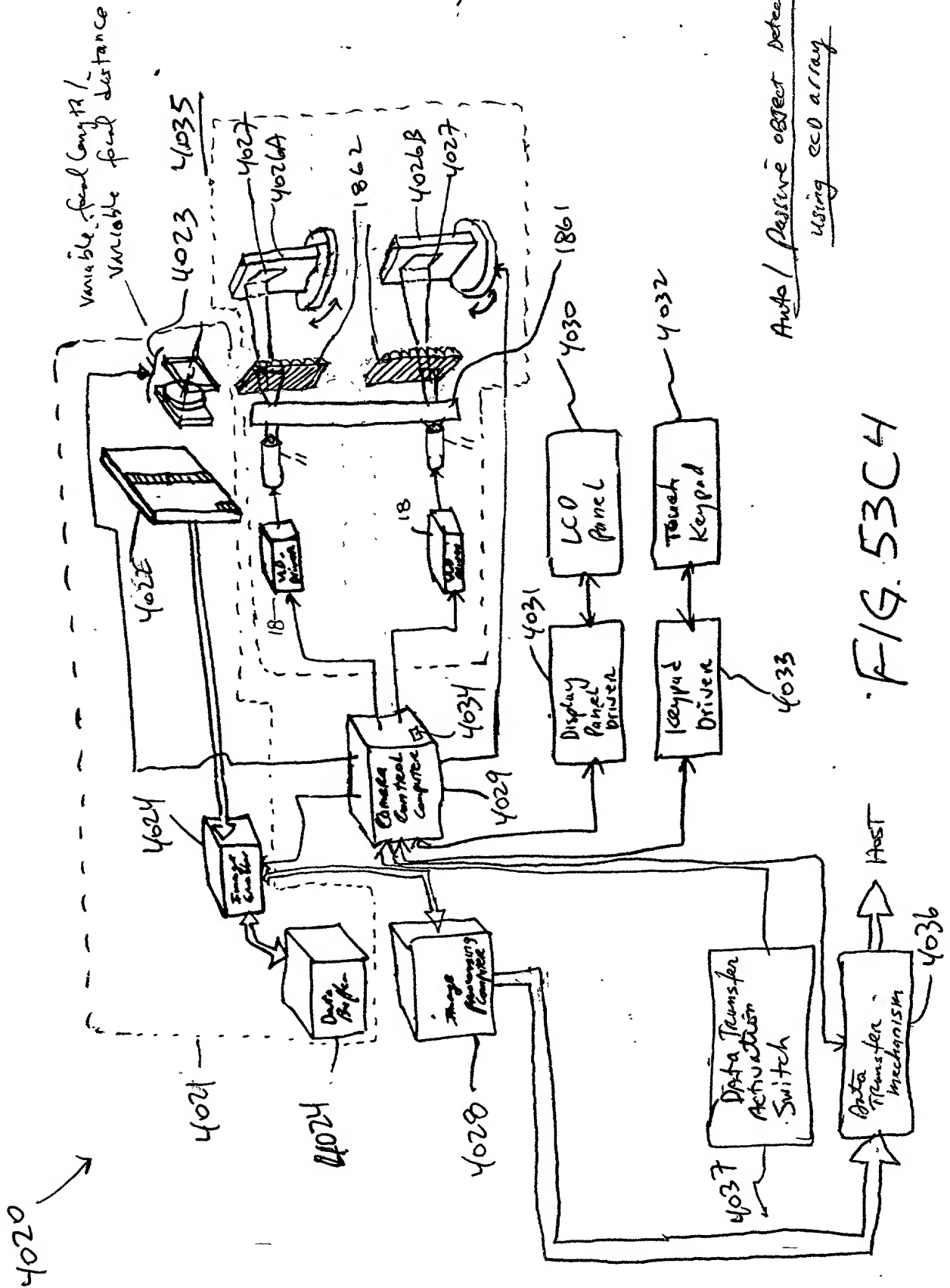
Auto / FR Object Detection

FIG. 53C2

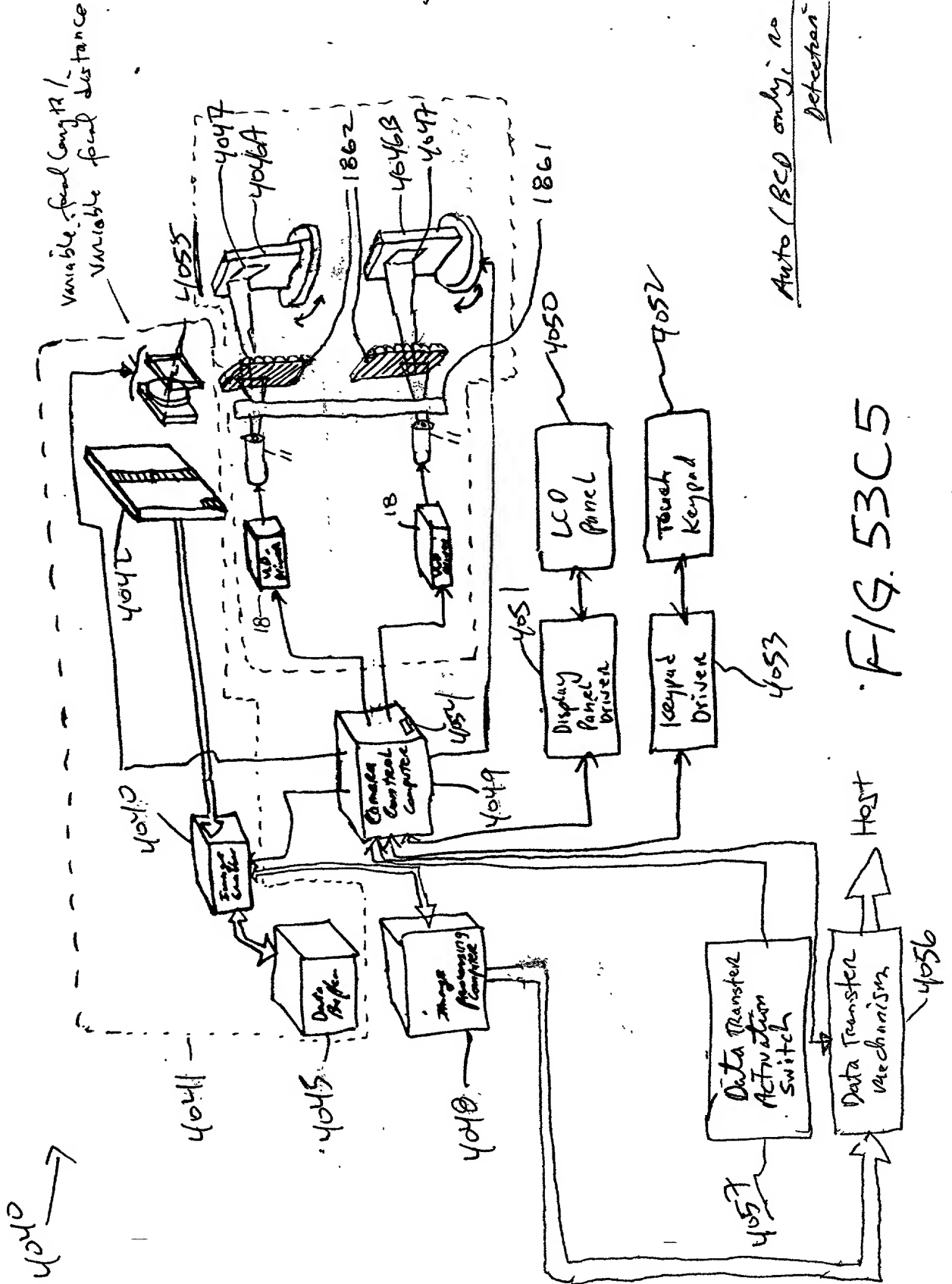


Auto / User object detection

FIG. 53C3



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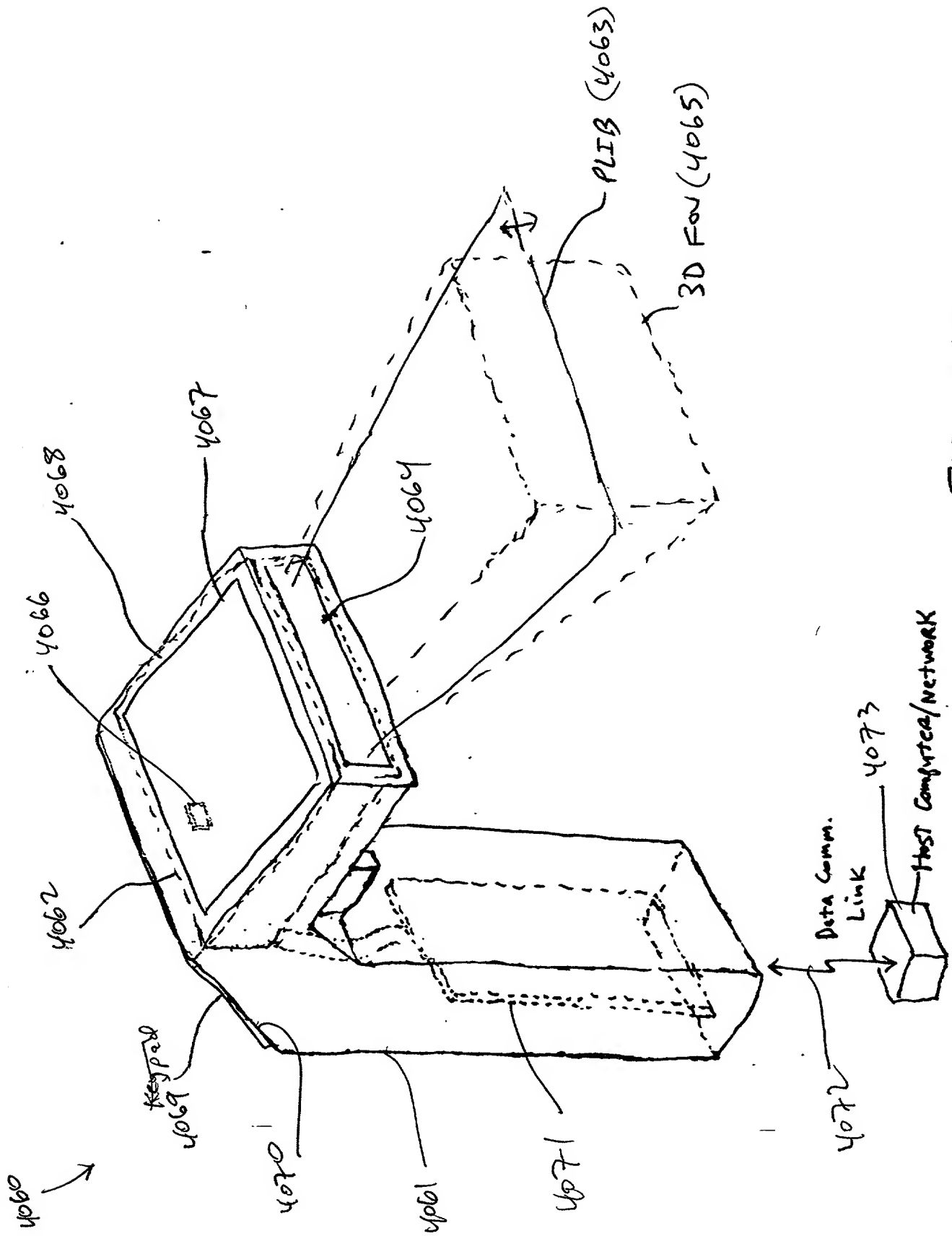


FIG. 54A

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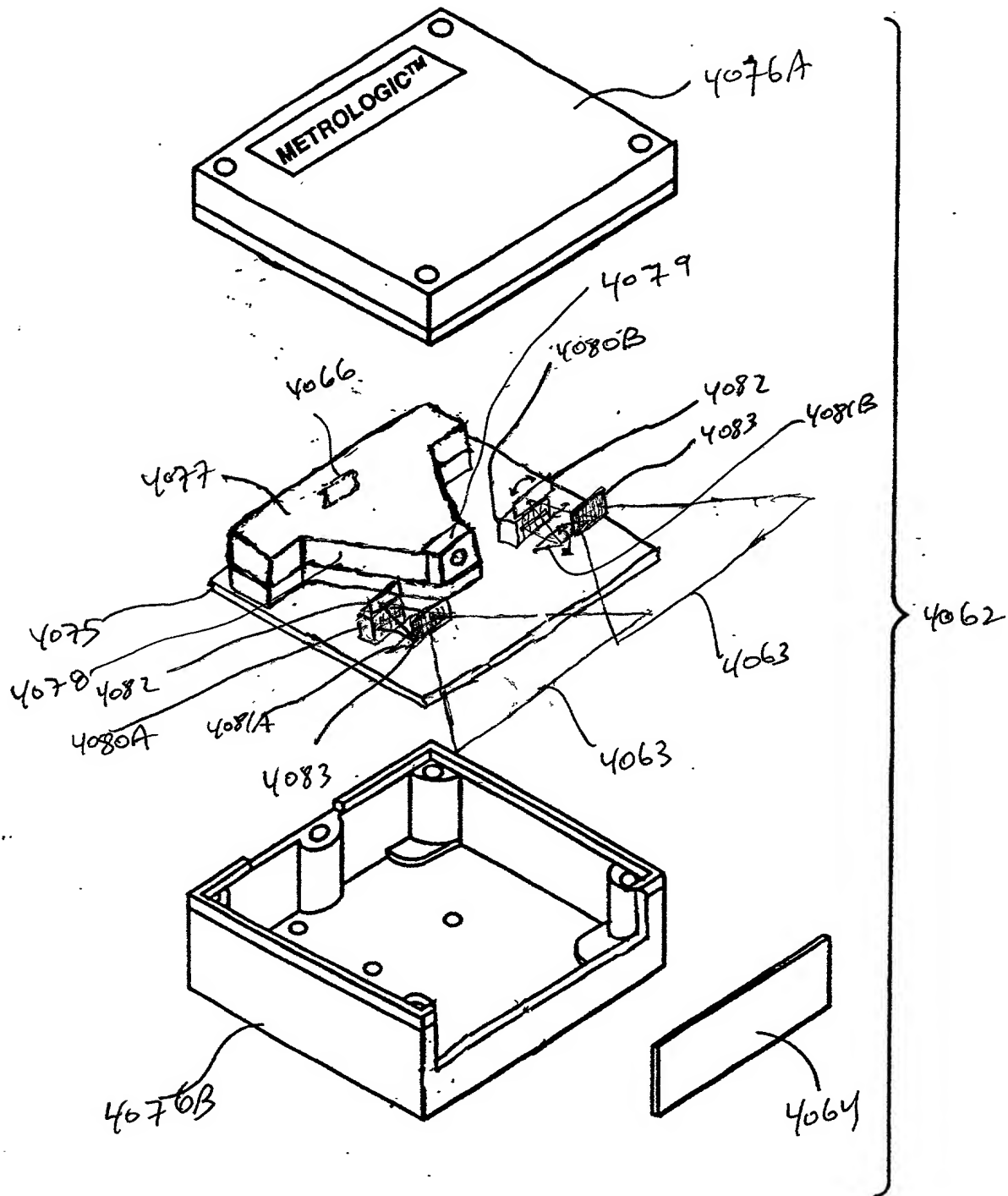


FIG. 54B

(dual mirrors)

Fig. 175A-SP1

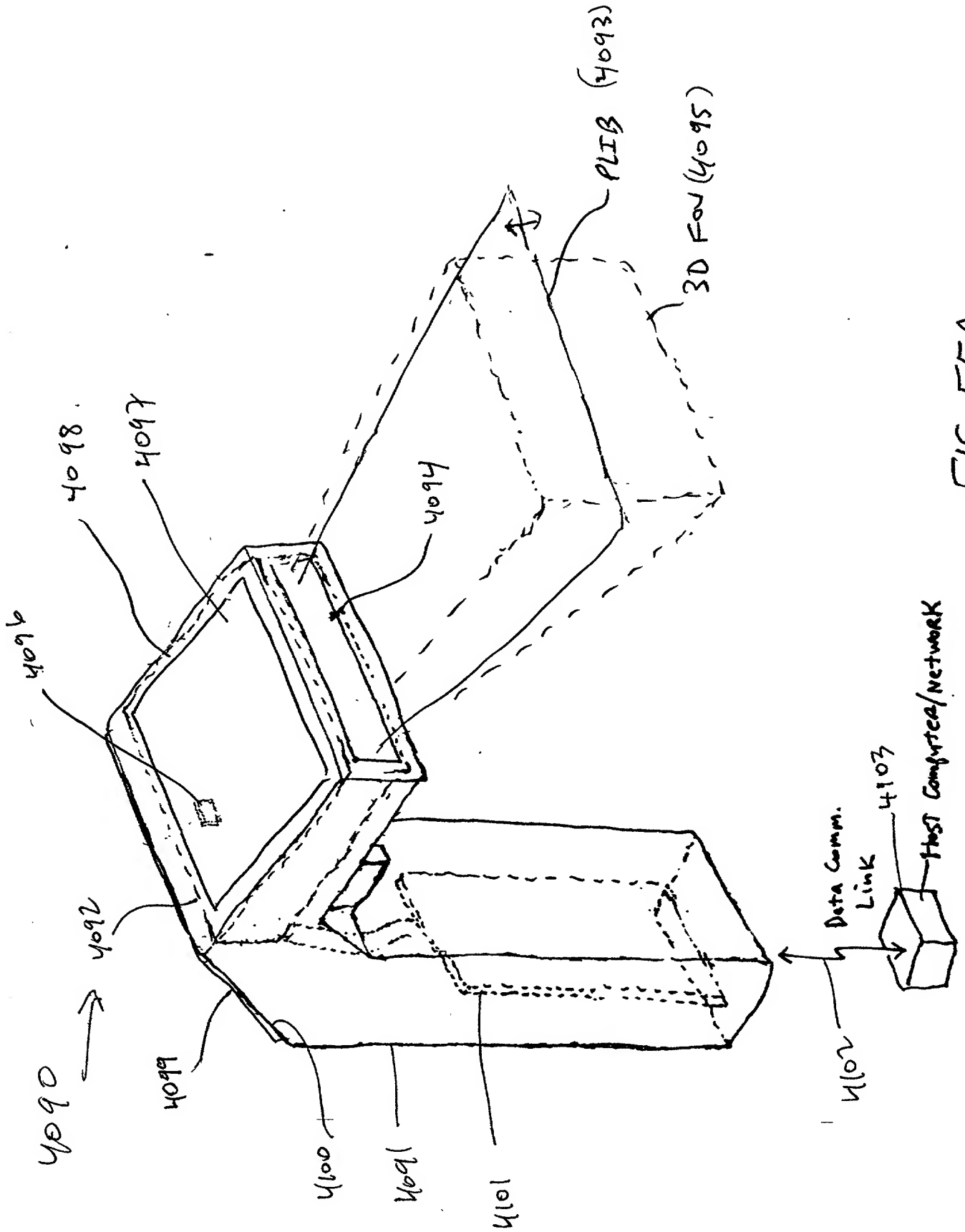


FIG. 55A

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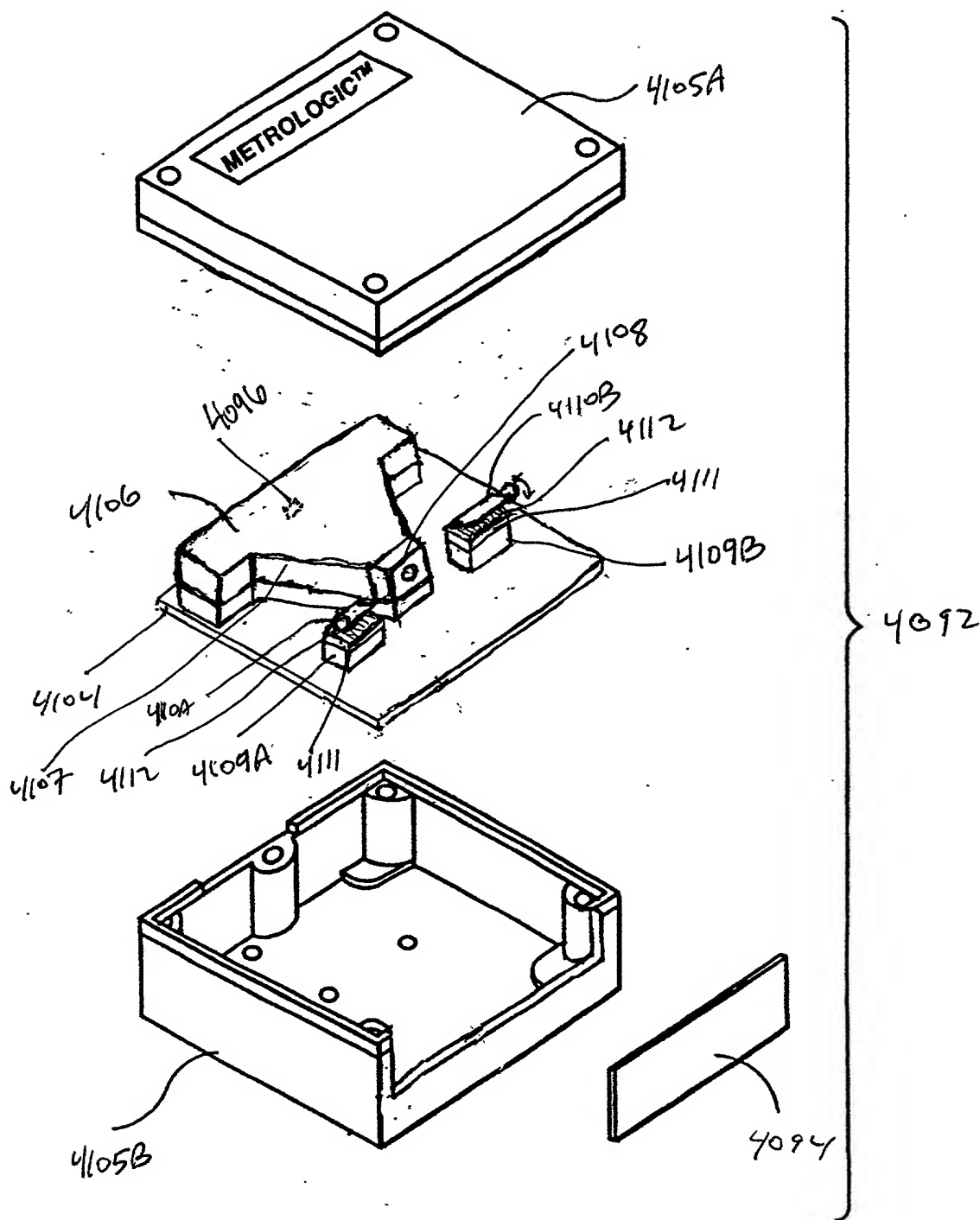


FIG. 55B

Brogg cell
Fig. 116A-6B

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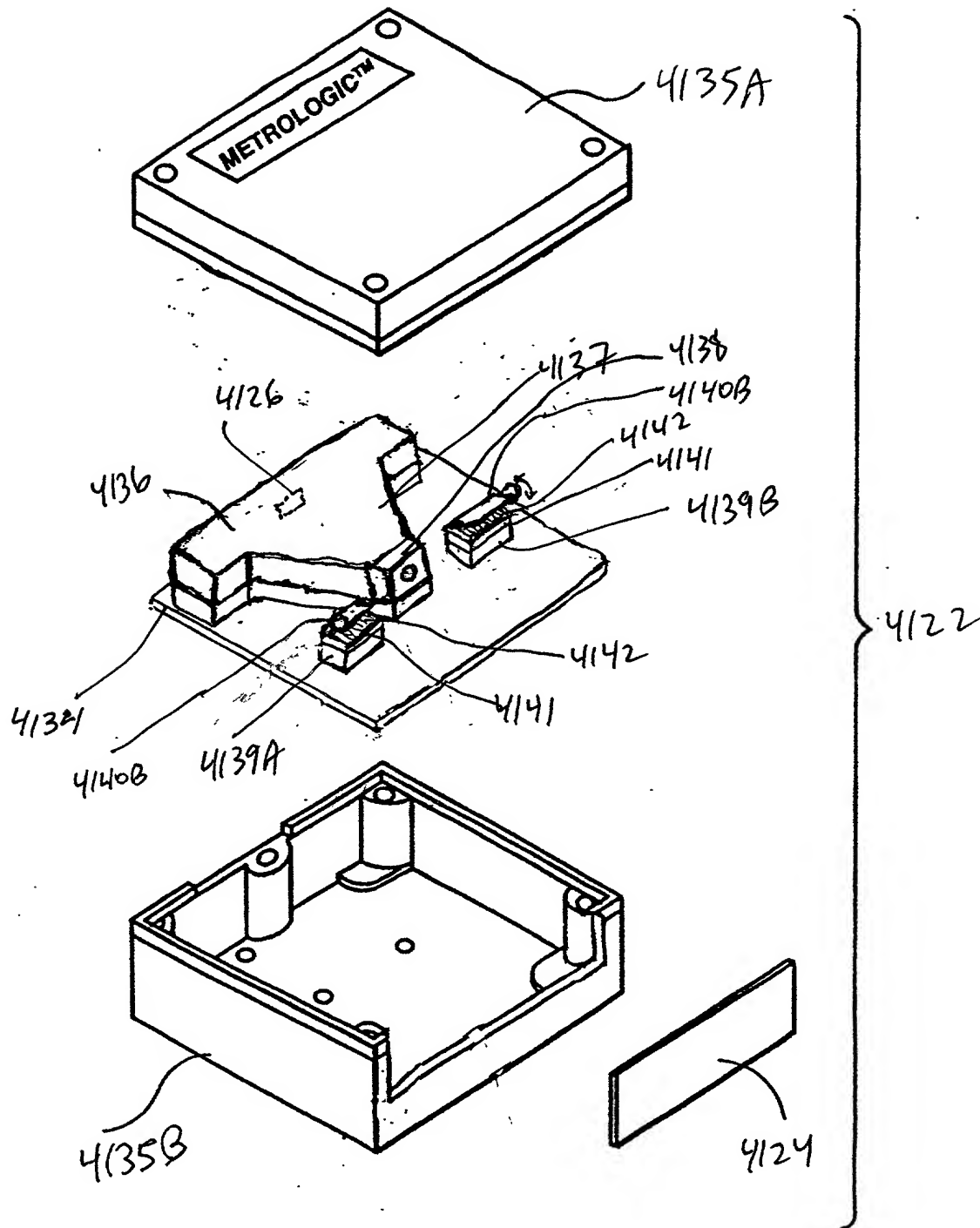
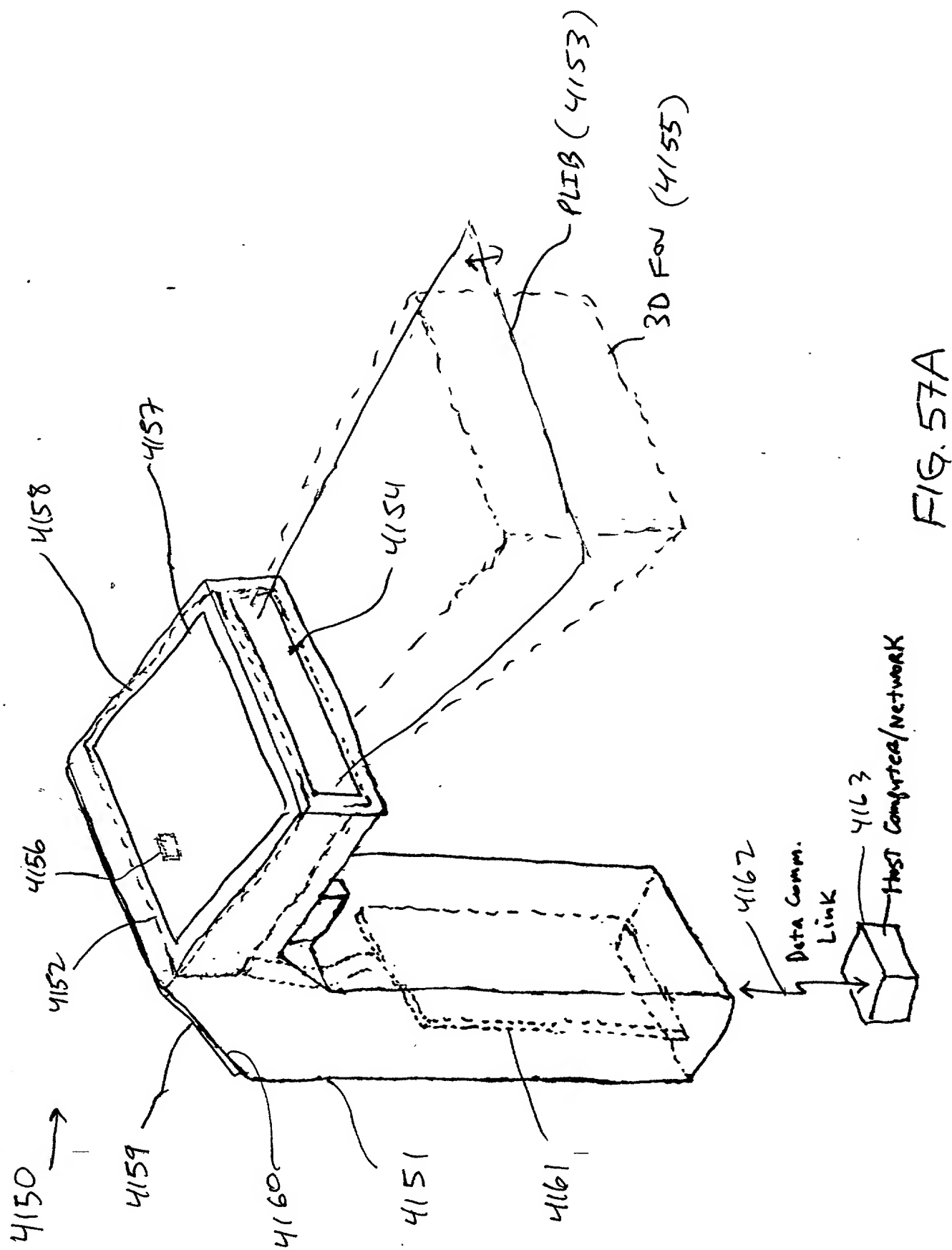


FIG. 56B

DM

Fig. 1F 7A-7C



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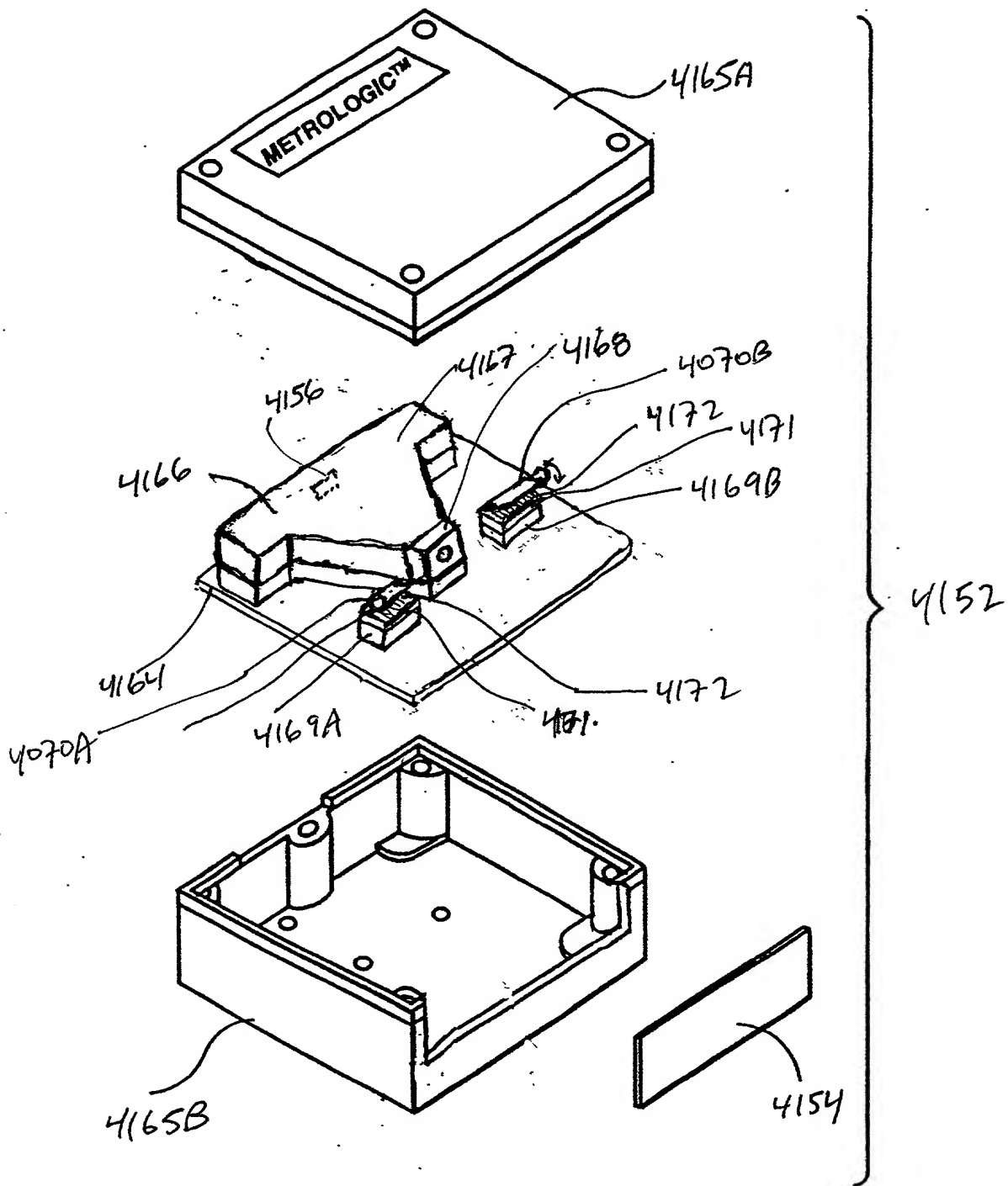


FIG. 57B -

Phase only LCD
PM panel

Fys 1F8F-86

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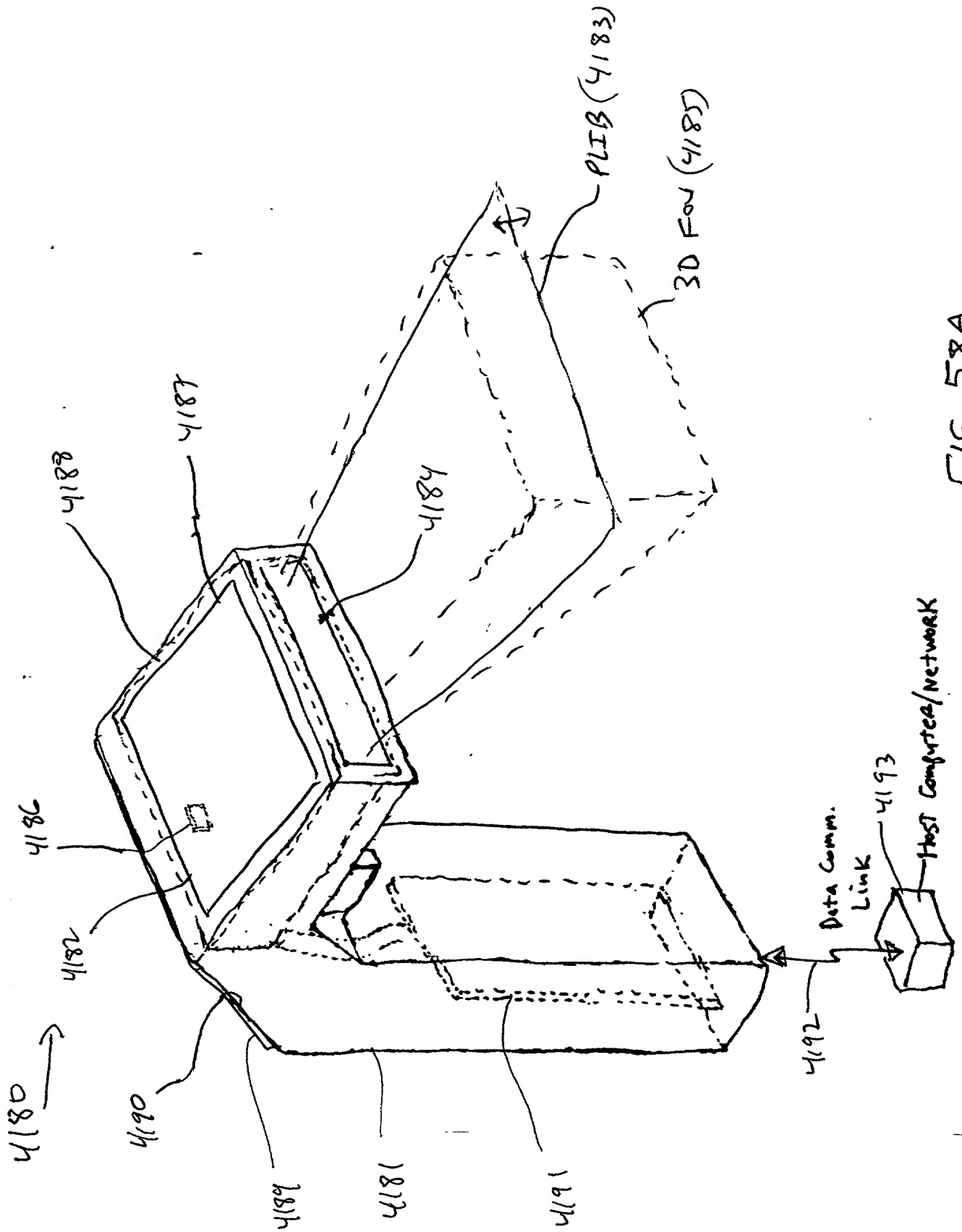


FIG. 58A

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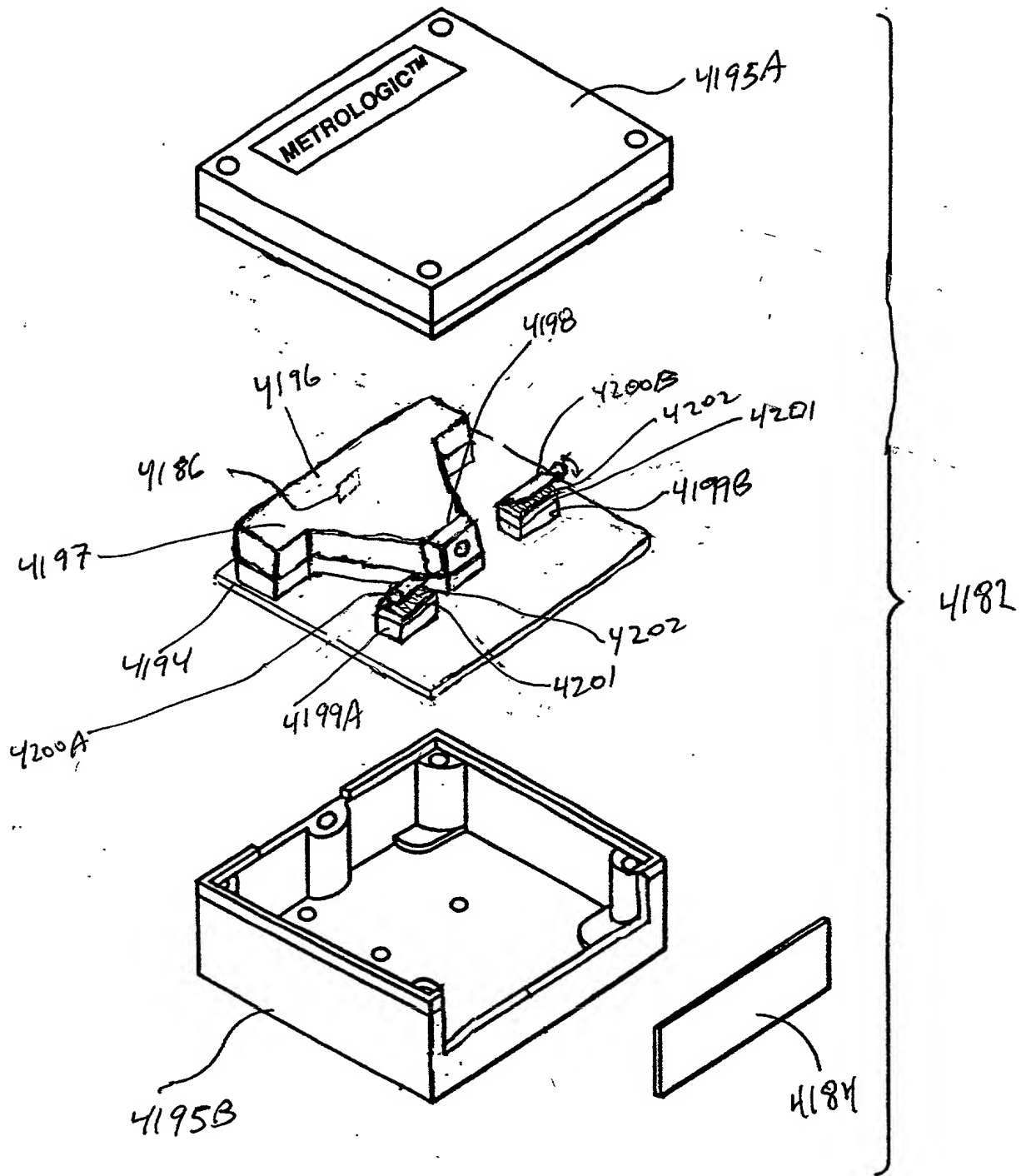


FIG. 58B

HS optical shutter

Fig. 1F14A-14B -

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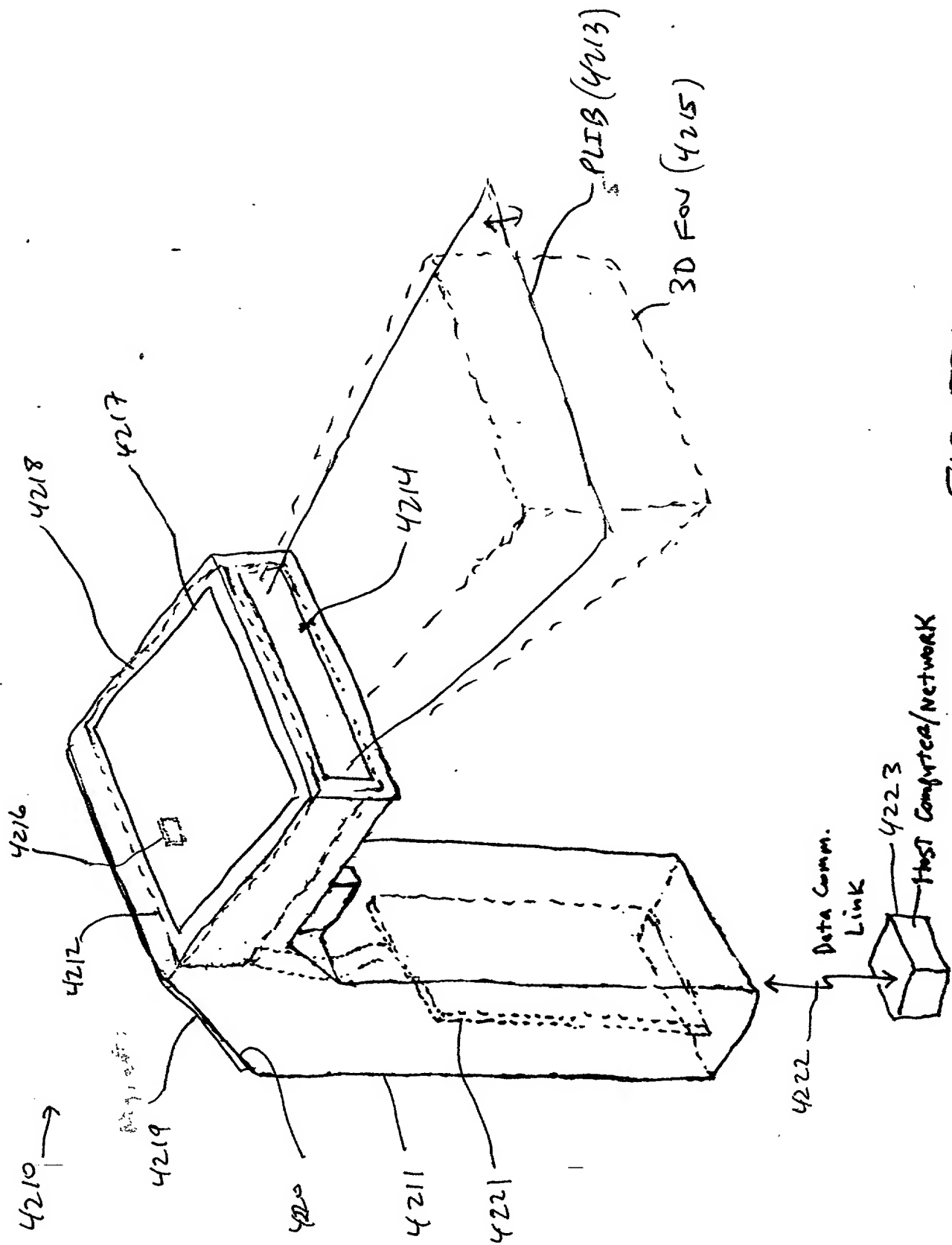


FIG. 59A

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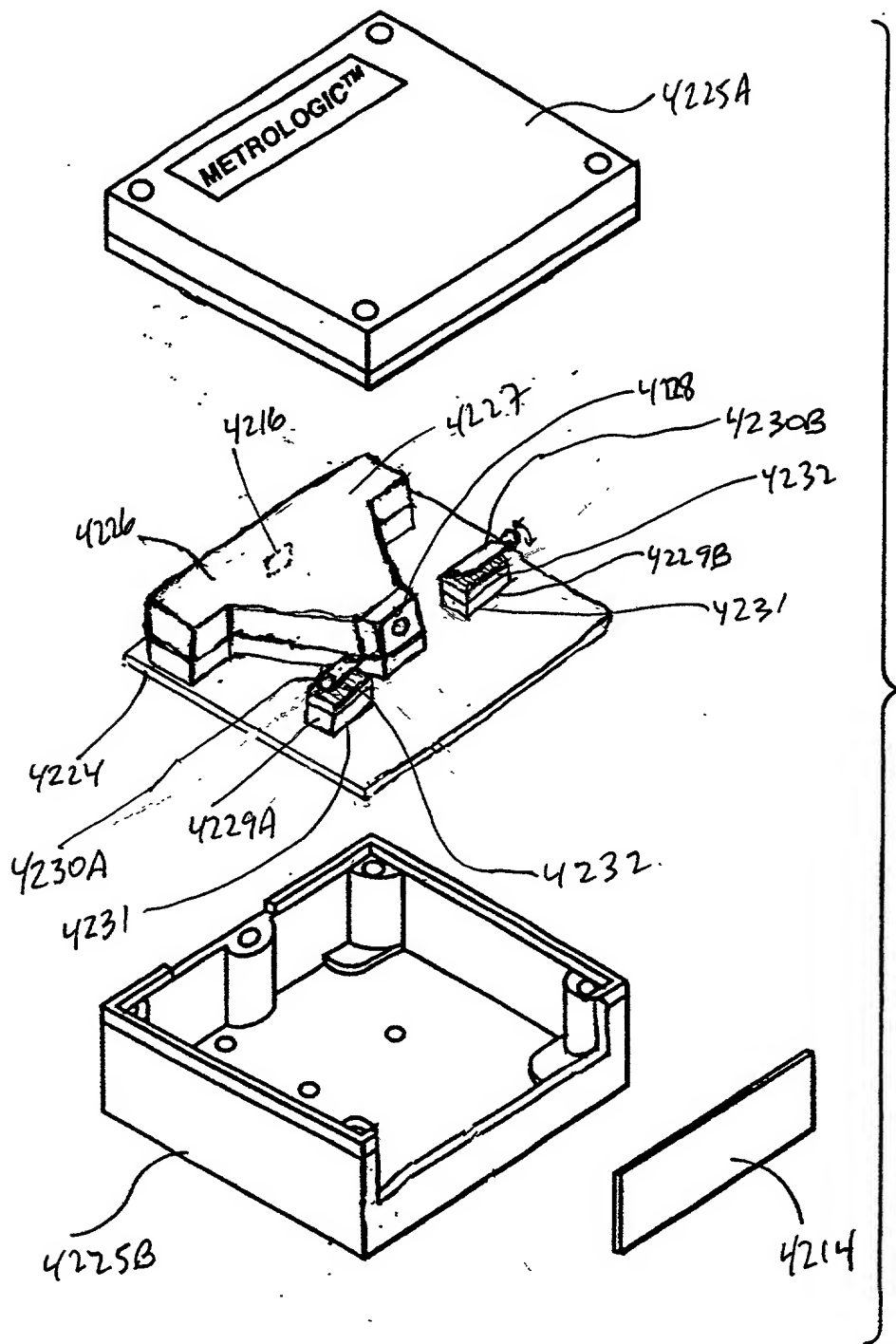


FIG. 59B

INCLD.

Fig. 15A-15B

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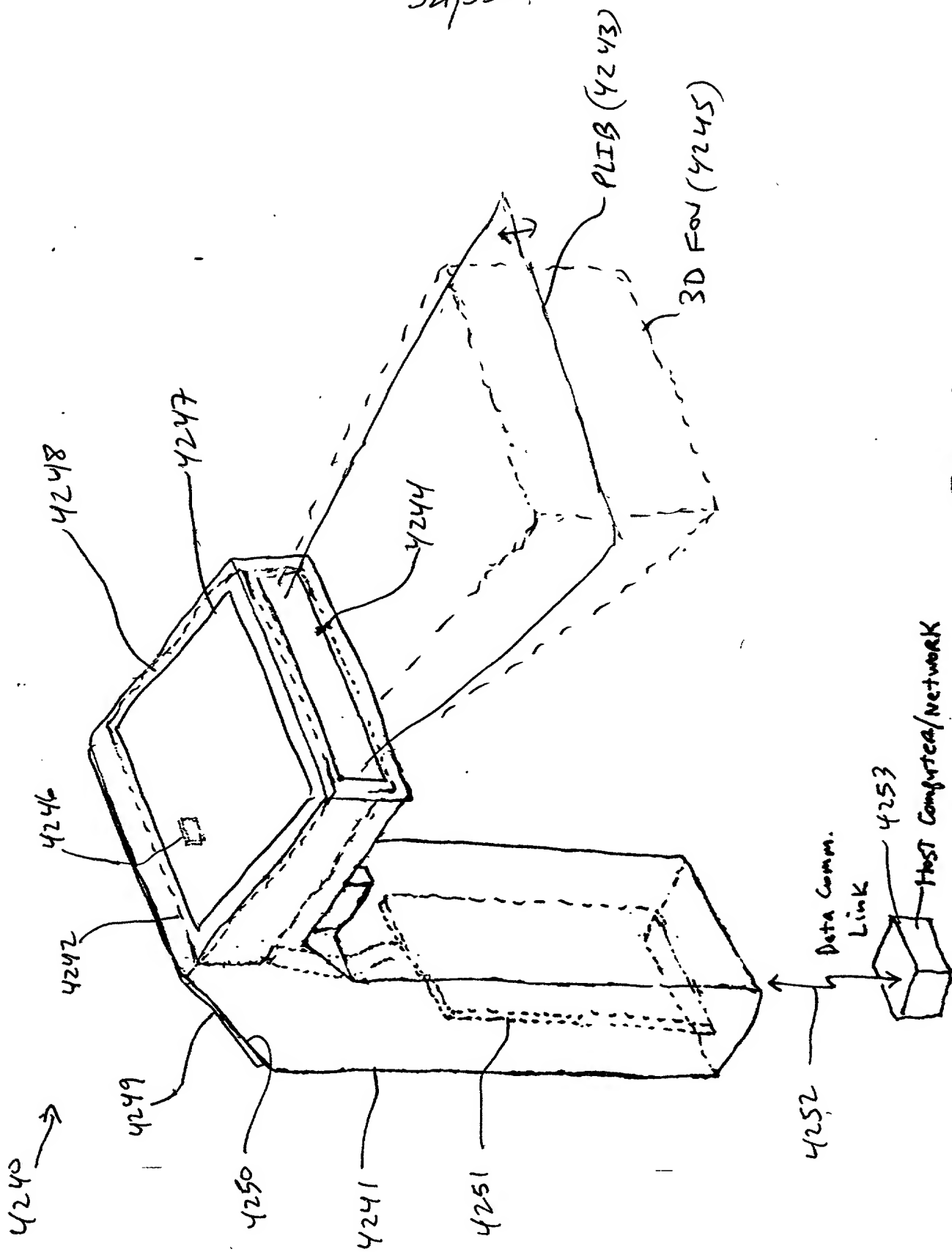


FIG. 60A

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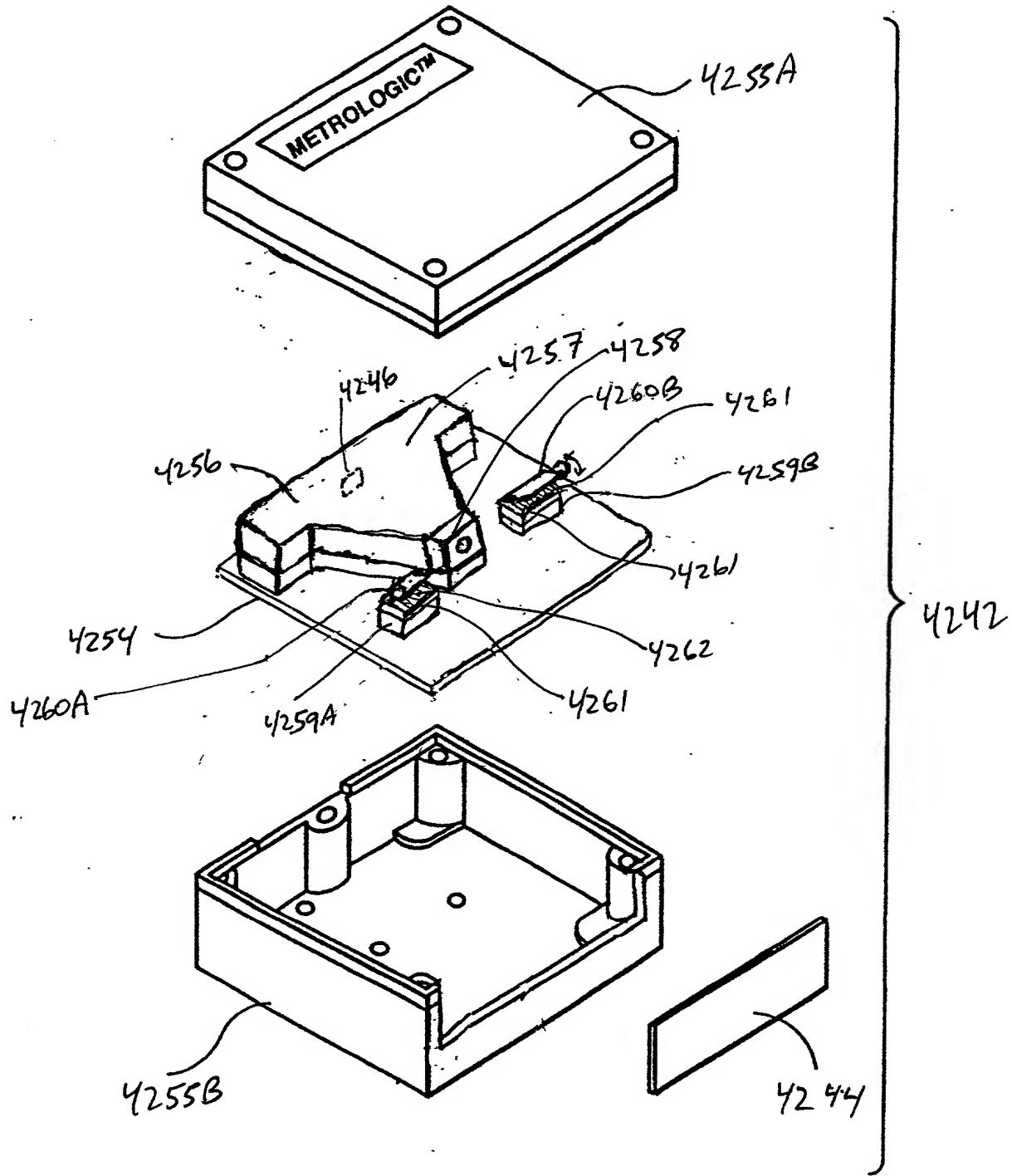


FIG. 60B

Bthalon (Tang. phase mod.)
Fig. 117A-17B

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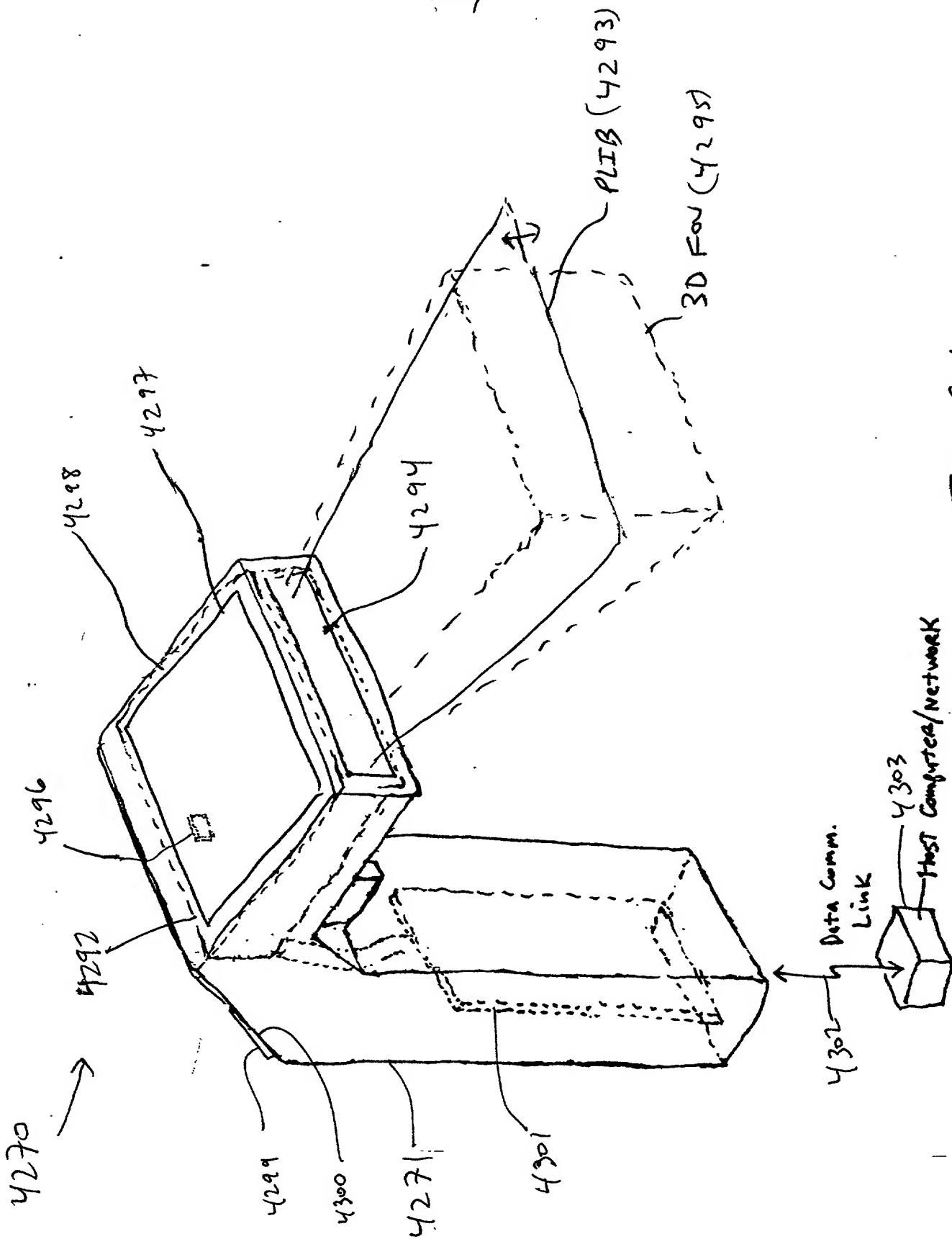


FIG. 61A

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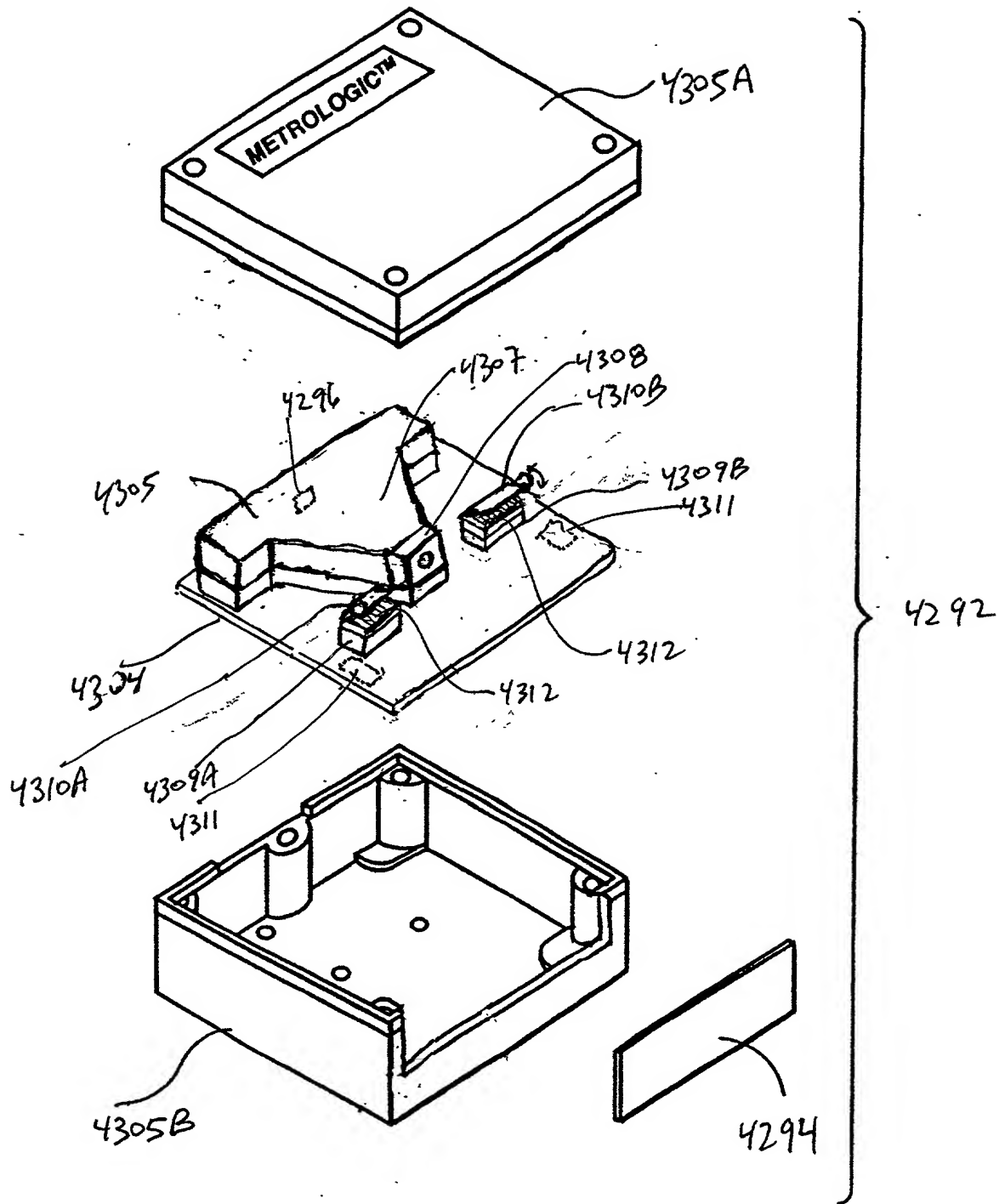


FIG. 61B

mod. hopping

Fig. 1A-19B

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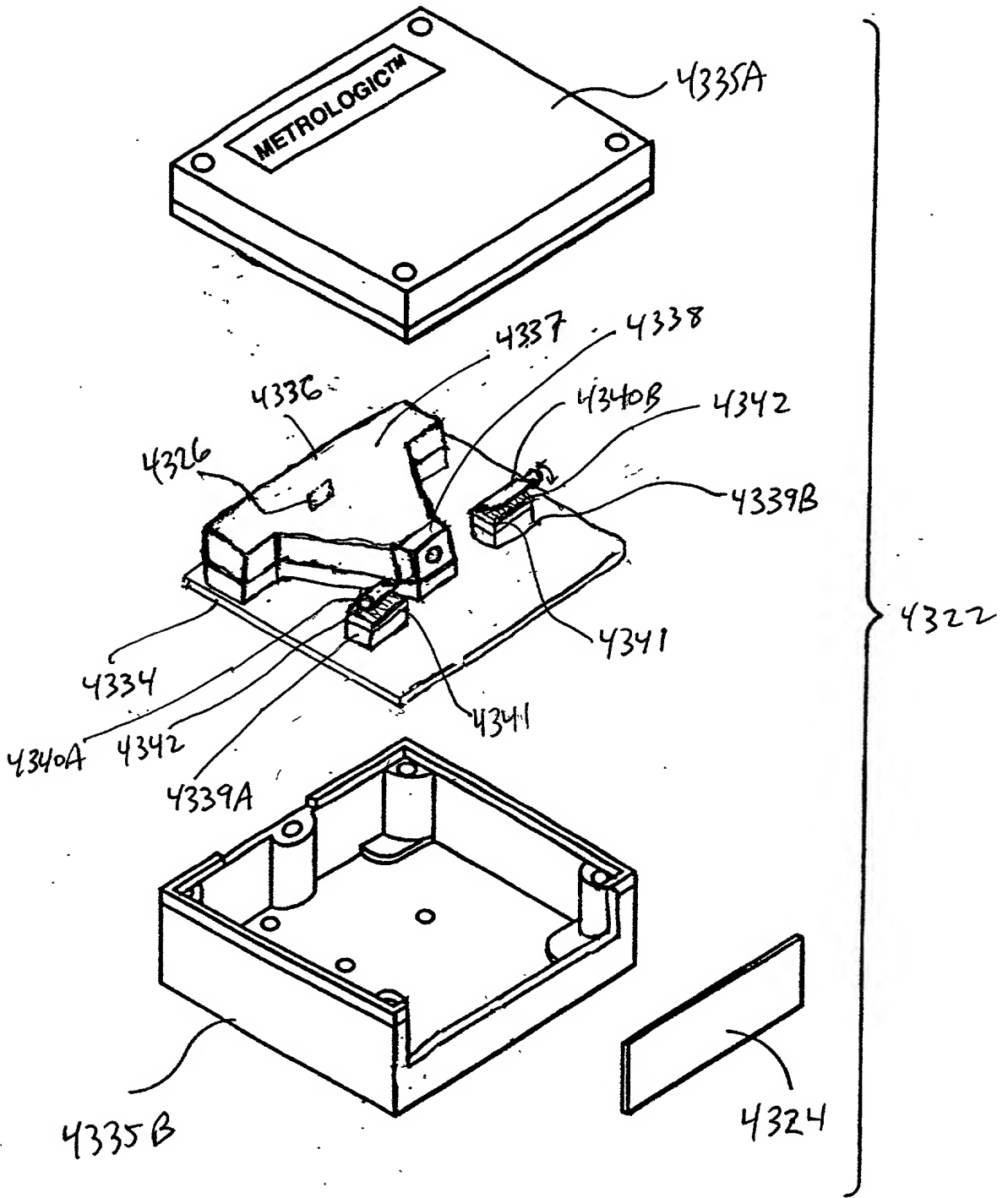


FIG. 62B

measuring
spatial intensity
mod. panel

Fig. 1E21A-21D

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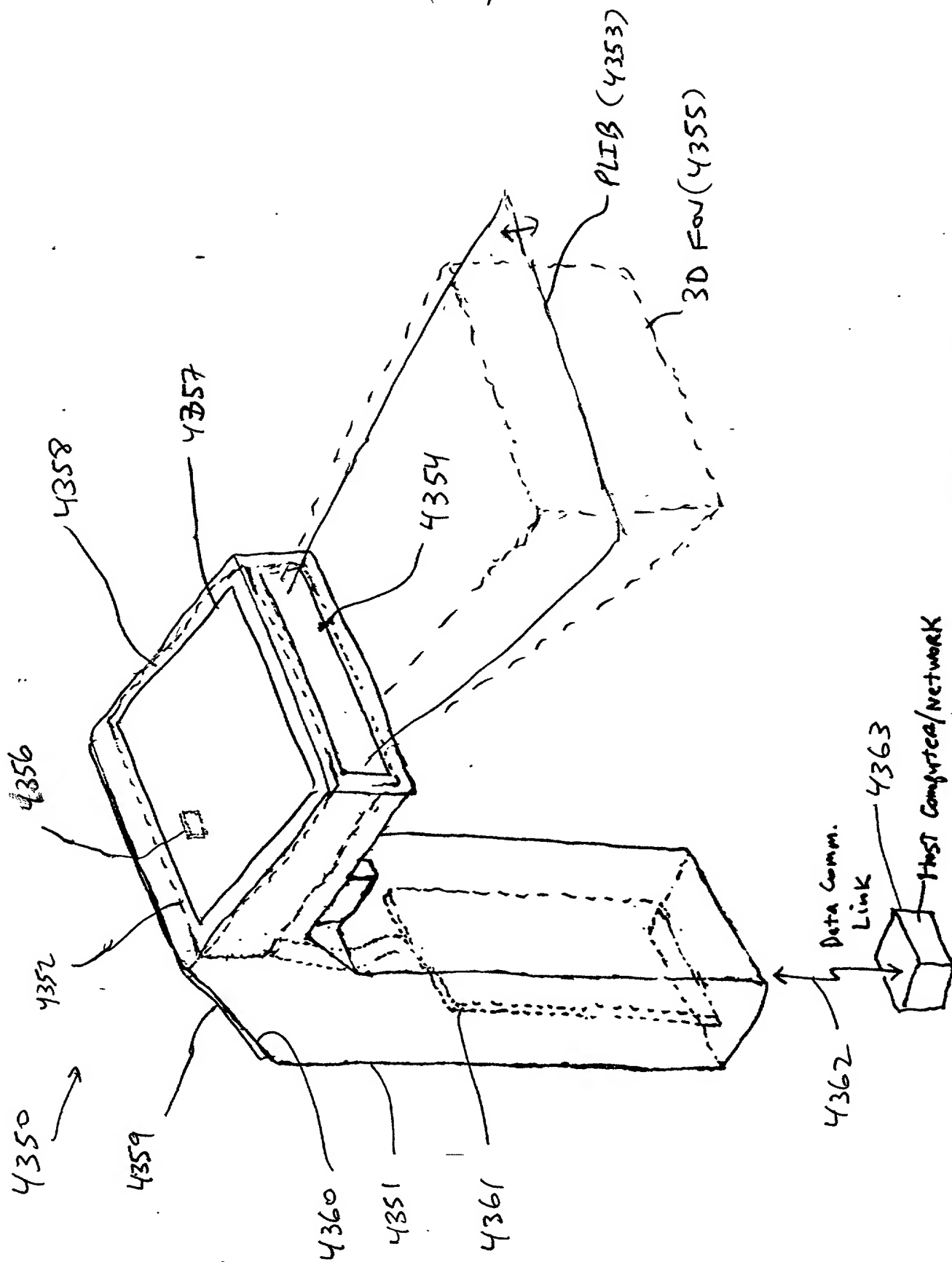


FIG. 63A

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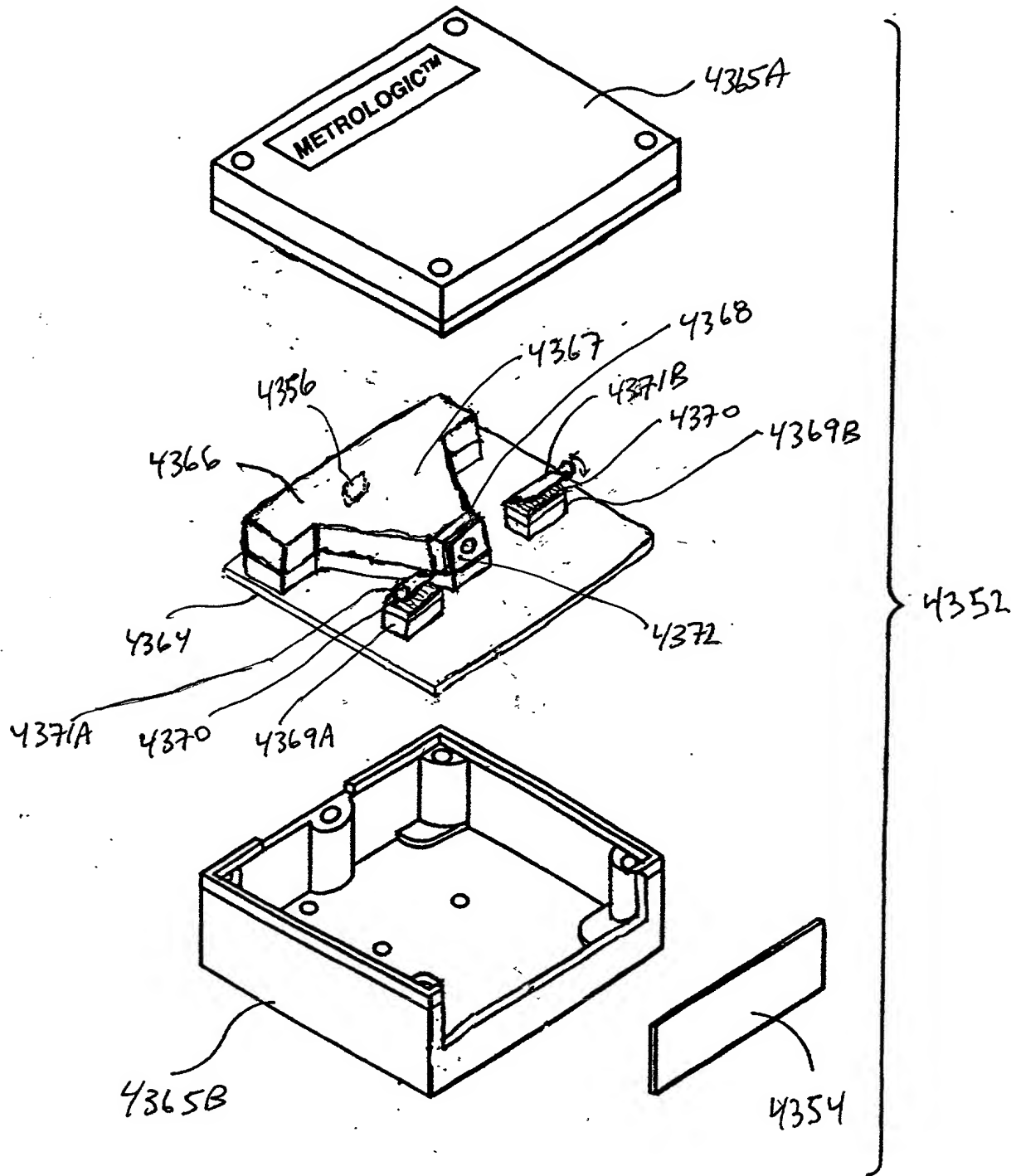


FIG. 63B

ED of
mechanical rotating IPIS

Fig 1F
23A-23B

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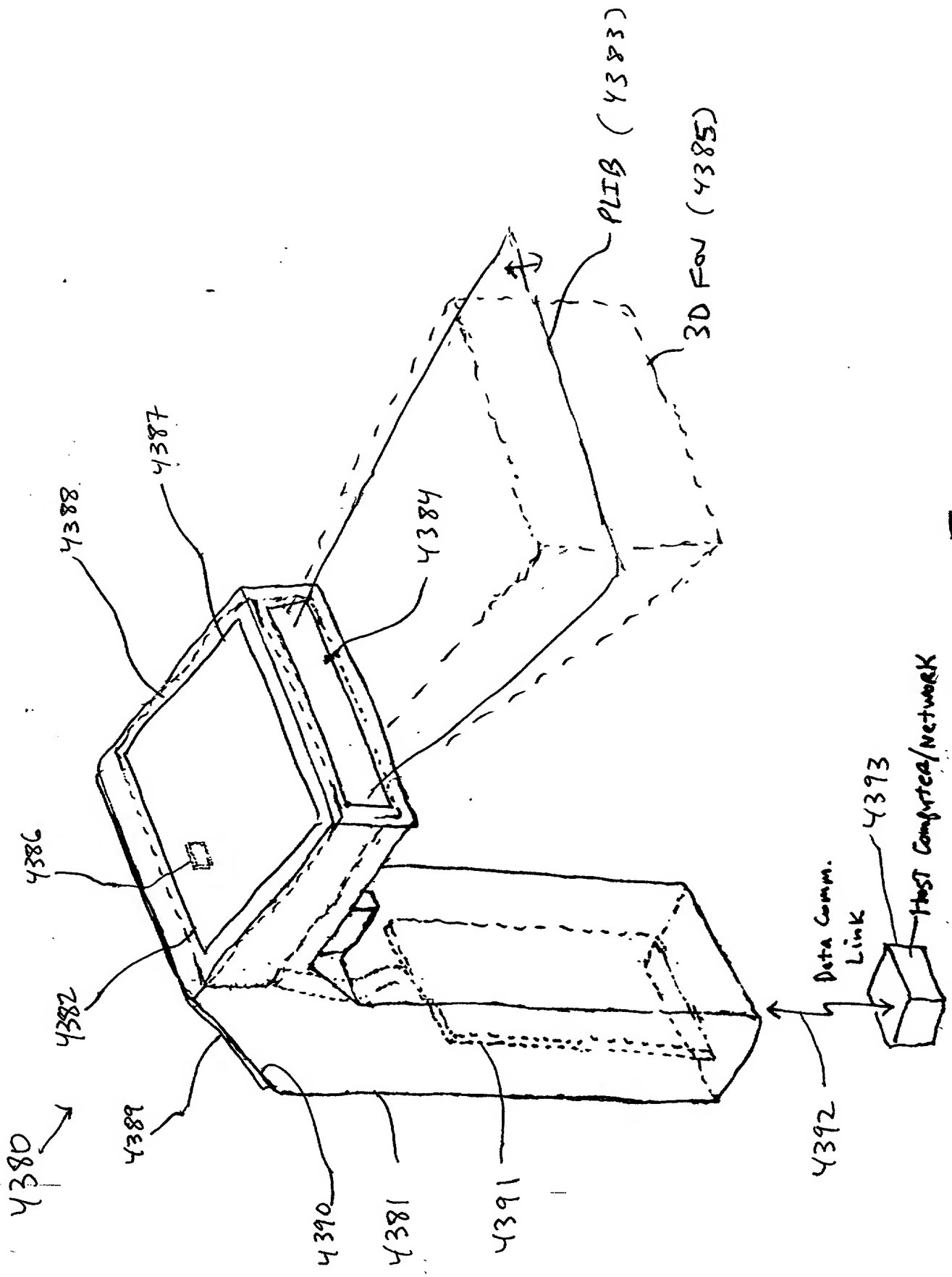


FIG. 64A

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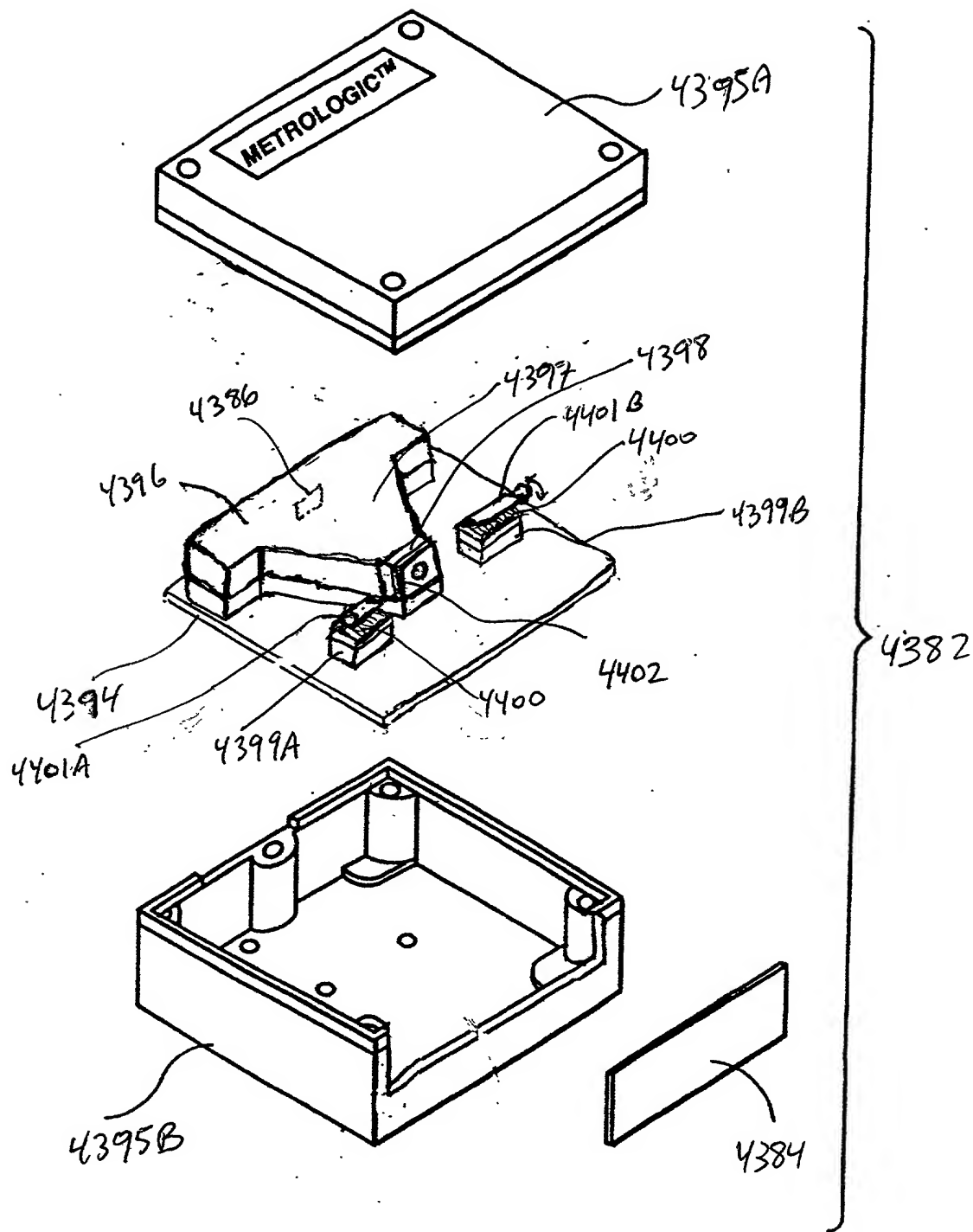


FIG. 64B

* E-optical
Shutter Before
FP Lens
Fig. 1E24A

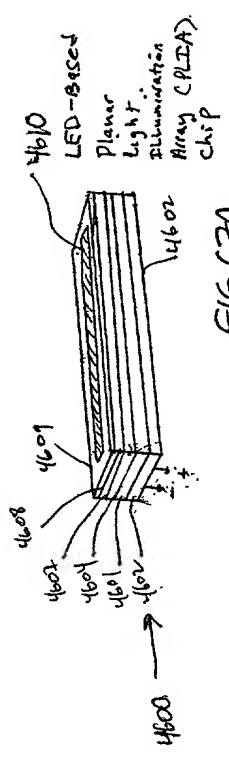


FIG. 67A

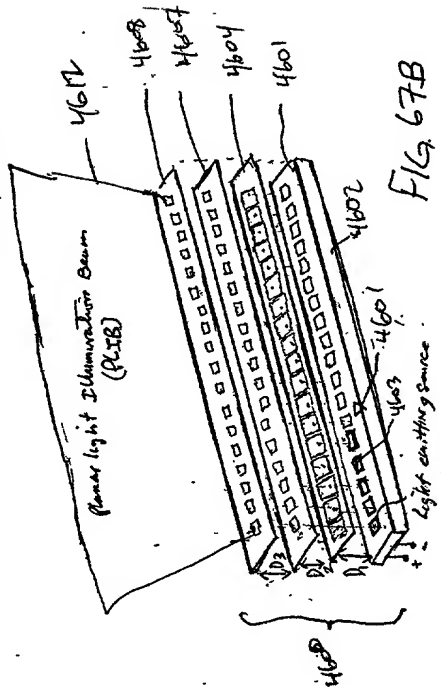


FIG. 67B

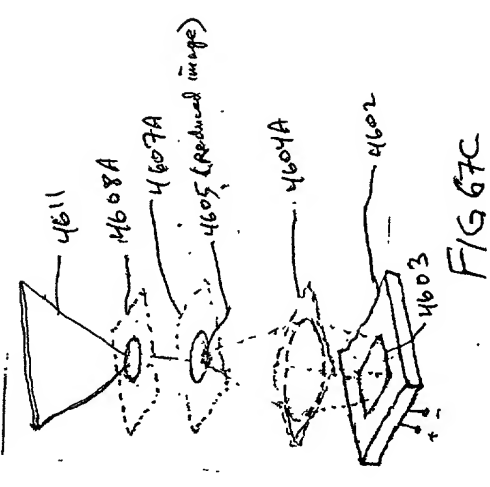


FIG. 67C

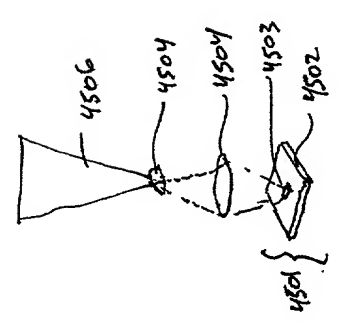


FIG. 65B

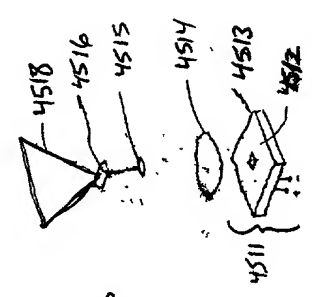


FIG. 66B

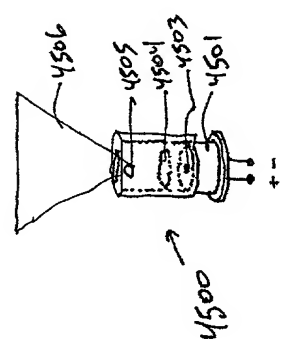


FIG. 65A

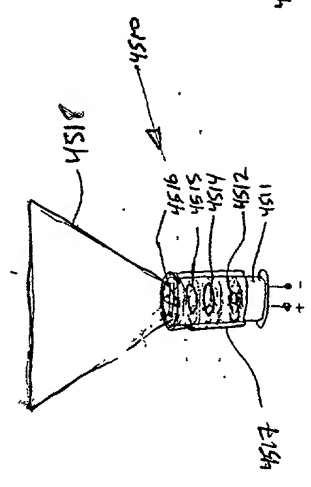


FIG. 66A

Baggage check-in Station #1

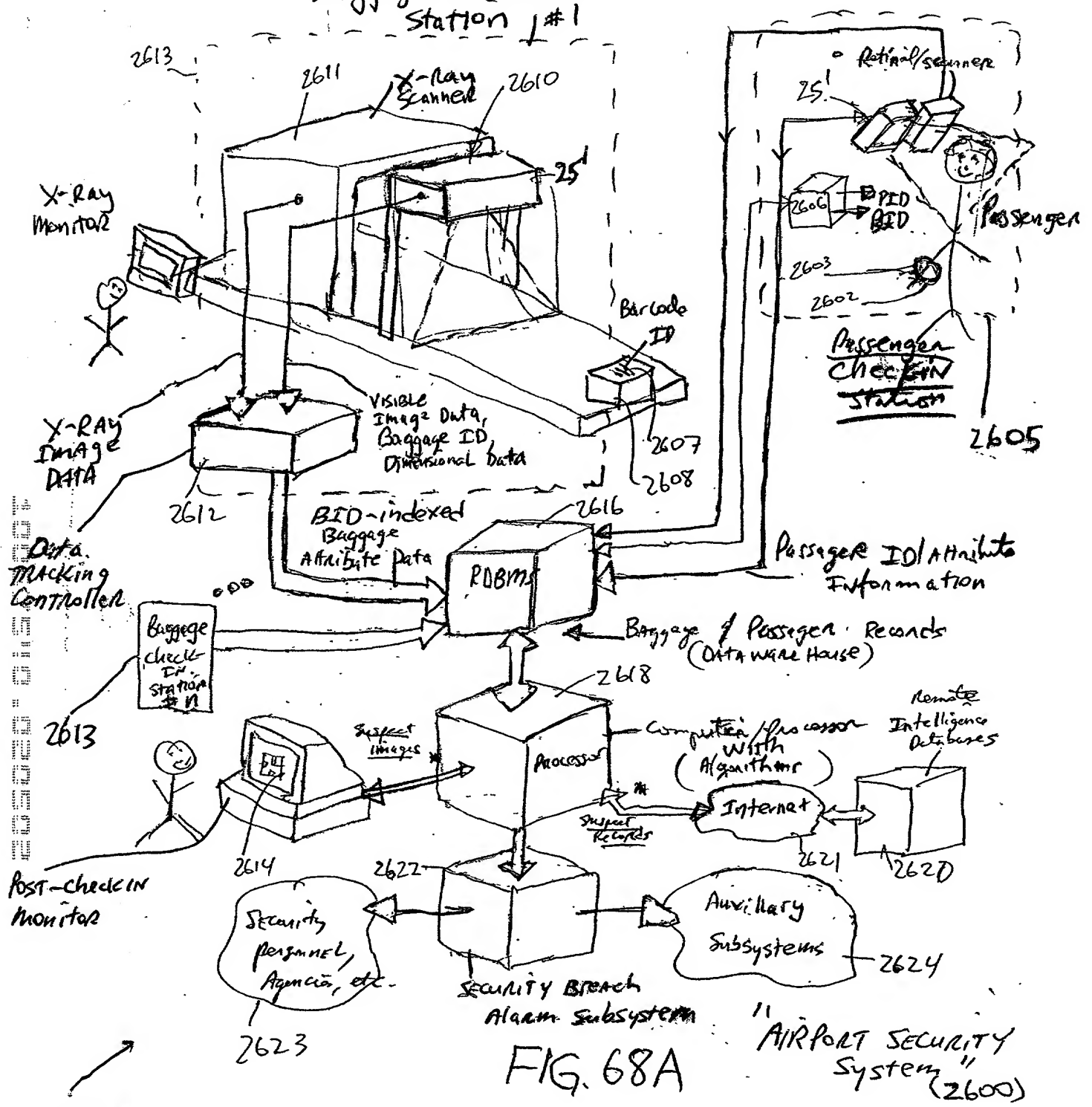


FIG. 68A

RDBMS Record X

Attribute data	2621
Passenger ID #	2620
Baggage ID #	2622
Baggage ID #	2622

FIG. 68B